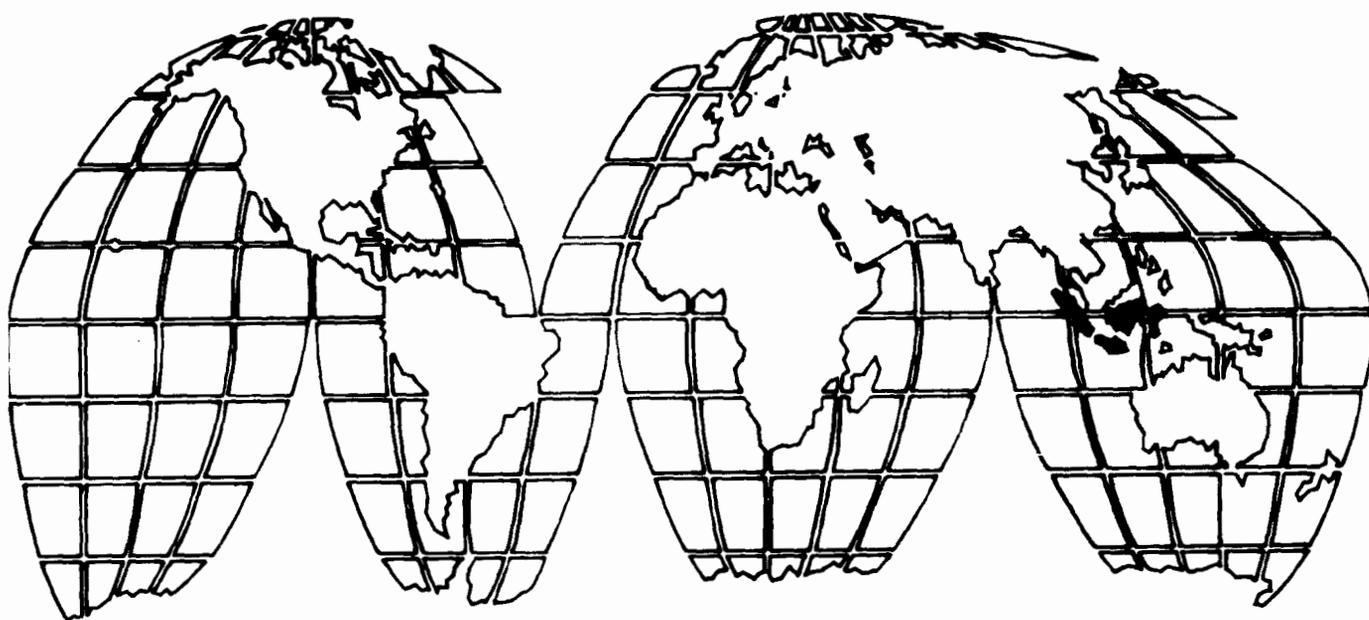


AID Project Impact Evaluation Report No. 29

Sederhana: Indonesia Small-Scale Irrigation

BEST AVAILABLE



February 1982

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SEDERHANA: INDONESIA SMALL-SCALE IRRIGATION

PROJECT IMPACT EVALUATION NO. 29

by

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February 1982

The views and interpretations expressed in this report are those of its authors and should not be attributed to the Agency for International Development.

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FOREWORD

In October 1979, the Administrator of the Agency for International Development (AID) initiated an agency-wide evaluation system focusing on the impact of projects funded by AID. Projects chosen for evaluation represent substantive areas of the Agency's program. Their impact is evaluated by Agency personnel, following procedures designed to ensure comparable and cumulative findings for use by AID and others in the development community.

This evaluation of the Sederhana Reclamation and Irrigation Program represents irrigation projects and assesses AID assistance to this small-scale irrigation program. It was conducted in May and June 1980. Issues explored in this report and in the impact evaluations of other sectors will be summarized and assessed in a final evaluation report. Cumulative findings will be used to provide guidance in planning future projects and in making policy and budget decisions.

SUMMARY

When the Sederhana Irrigation and Reclamation Program was initiated by the Government of Indonesia (GOI) in 1974, it signalled a new focus to long-standing efforts to increase rice production. Sederhana was designed to rehabilitate or construct small, technically simple irrigation systems, each serving fewer than 2,000 hectares. The program was to be rapidly implemented throughout the vast Indonesian archipelago with a minimum of detailed planning. With improved systems to increase the supply, reliability and coverage of irrigation water, it was intended that farmers would increase their rice production and their incomes, and the country would benefit from a corresponding decline in rice imports.

Participation by the Agency for International Development (AID) in the Sederhana program began in June 1975 with the authorization of a \$20 million loan that was increased to \$23.7 million in 1976 (Sederhana I). AID support of the Sederhana program was consistent with its mandate for rural development and assistance to the rural poor. Areas totalling 550,000 hectares targeted for development and AID assumed 40 percent of the total projected project cost. The primary purpose of AID support was to improve the institutional capacities of Indonesian agencies responsible for implementing the program. The Ministry of Public Works (MPW), specifically the Directorate General of Water Resources Development was responsible for the construction of the irrigation systems. The Ministry of Agriculture (MOA) was to help develop farmer water user associations, supervise farmers in the construction of tertiary canals and farm ditches and provide extension services. Lack of coordination between the Ministries has been a concern throughout the program. The agricultural or farm level aspects of Sederhana -- development of water user associations, water management and system maintenance as well as extension services for inputs and advice on cropping patterns -- have constantly been playing catch-up with construction, the more visible aspect of the program and the one which commands the lion's share of the funds. In 1978, additional funds totalling \$29.5 million were committed to continue and extend the activities of the Sederhana program (Sederhana II). AID approved Sederhana II before any funds from the original project had been spent to reimburse actual construction of irrigation systems.

The project proved difficult to administer. Although about 600 subprojects were completed or underway by June of 1980, only 52 had been certified for reimbursement by AID under Sederhana I. The slow rate of reimbursement was due to start-up problems, to design and construction faults that required work to be redone, and to the fixed amount reimbursement (FAR) method used by AID to fund the program. Under the FAR method, a pre-agreed payment for each subproject took place only after construction was completed and certified by technical consultants to be satisfactory. It was argued that this method would eliminate the problems of cost overruns, support the entire program rather than individual subprojects, and allow AID disbursements to continue at the pace of project implementation until the funds were exhausted. Since the Sederhana program and hundreds of subprojects scattered throughout Indonesia, certification became a time-consuming and cumbersome activity. While it did appear to assure certain construction standards, it probably did not meet the need for more substantive technical assistance in

the design and construction of so many small systems in diverse physical and social environments. The few technical assistance consultants were left with little time to concentrate on transferring skills and knowledge to their Indonesian counterparts.

Most of the irrigation systems that had been reimbursed under Sederhana I were well constructed. The water users associations that were to be formed as part of the program, however, did not appear to be operating and maintaining the systems as intended. Water management practices varied considerably, depending upon the abundance and reliability of the water supply, farmers' experience with management of irrigation systems and traditional local leadership.

In most of the 29 subprojects visited on Java, Sulawesi and Sumatra, Sederhana's impact on local rice production was substantial despite the difficulties of implementation. On Java, where there is a long tradition of rice farming, production increased substantially at most of the sites visited. On Sulawesi, rehabilitated irrigation systems frequently permitted an additional rice crop each year. Yields increased by as much as 2 tons per hectare. The production of dry land crops also improved. On Sumatra, however, the production impact was not encouraging. At many sites, environmental conditions such as soil and climate did not appear favorable for growing high yielding varieties of rice. The program's emphasis on rice production appeared to be meeting with resistance both from farmers who could not or did not want to grow high yielding varieties and those who did not want to switch from a profitable cash crop such as coffee to a rice crop which requires a great deal of labor (in short supply on Sumatra) and which they were not accustomed to growing as a principal crop. Local production impact has confirmed an assumption in the Sederhana concept that farmers could make immediate use of additional water. The variability of success represented by the subprojects visited in the course of this evaluation, however, presents some of the limitations which this national program confronts in specific local environments.

In most subprojects, increased production provided landowning families with an increased food supply to consume at home or to barter for other foods. Occasionally surplus production was sold for cash income. Most tenants with stable tenancy arrangements also realized a net gain from increased production, but sharecroppers and landless laborers were sometimes affected adversely. As farm work became more profitable, underemployed members of landowning families assumed many of the new requirements for labor in the improved Sederhana systems.

Overall, although rice production has increased, so too have per capita consumption and population. Indonesia continues to import more rice than ever before. This production is to keep pace with population, the Sederhana program must continue to improve its effectiveness. From the Sederhana experience between 1975 and 1980 the team drew the following lessons which may contribute to future development efforts:

- Programs with many subprojects designed for rapid implementation inevitably confront trade-offs between quantity and quality. A centralized design and approval process permits rapid and high volume design work, but depends upon accurate site survey information to ensure appropriate results. Increasing local participation is beneficial if it can improve site survey information and encourage farmers to become involved in making the project successful. Decentralizing the design process and working to increase local participation can improve the effectiveness of implementation, but reduces the number of subprojects that can be undertaken.
- Coordination of the construction and production aspects of a project is difficult, but essential to success. Where coordination is necessary to achieve project results, AID should not assume it will occur automatically, but should realistically assess the incentives for various institutions to perform as expected.
- The balance of technical and capital assistance needed depends on the maturity of the project and the various technical difficulties that it presents. Technical assistance is more important in the early stages of a project to prevent costly errors and to help build skilled and experienced personnel within the government ministries. It is also essential in remote areas where isolation exacerbates administrative and technical coordination.
- Farmer participation is essential to sustained progress in agricultural development particularly in diverse and scattered project environments. Experience indicates that including farmers in the planning and implementation of subprojects can improve the selection of sites, alleviate right-of-way problems and foster more active water users associations for effective operation and maintenance. Farmer participation is the most effective means to ensure that farmers invest in a system that requires their care and skill to sustain.
- Farmers indicate that the greatest value of the irrigation system is the reliability of the water supply. While production increases are also valued highly, farmers prefer stable yields to yields that vary from a bumper crop one year to a bad crop the next. The greatest benefits of a small-scale irrigation system, then, are those that first assure water security and build water management activities and other production increases on that solid base.
- Without baseline data or a well-conceived evaluation system, assessing the progress of a project is difficult. The nature of benefits expected from a project and their value to the beneficiaries should be clearly stated at the outset and some indicators should be chosen to measure those benefits as the project matures.
- Programs such as Sederhana can provide substantial benefits for the rural poor, but cannot achieve redistribution of the wealth. Other national development efforts such as land reform can complement agricultural development and permit broader distribution of its benefits.

PREFACE

The observations and qualitative judgments presented in this report are meant to illuminate rather than narrowly define the experiences of the Sederhana program. The authors hope the report will encourage others to explore the lessons of the Sederhana program and integrate these lessons into future development efforts.

In reviewing the lessons learned from evaluations of development projects in other sectors of this series, there is a strikingly consistent theme--that participation of the project's beneficiaries is as essential to the successful project as any physical input, and that sustaining the benefits of development projects depends increasingly on the interest, care and support provided by beneficiaries.

ACKNOWLEDGEMENTS

We wish to thank the Indonesian Government for providing staff and logistical support and Suyono Sosrodarsono for his time and valuable views of the program. Appreciation is also extended to the AID Mission staff for its generous assistance to the team's logistical needs and to Gunawan Widjaja and Juliana Sahulata whose understanding of their country, its language and the Sederhana program greatly facilitated this evaluation. Invaluable assistance was also provided by the provincial staff of both the Ministry of Public Works and the Ministry of Agriculture whose knowledge and experience contributed to the team's understanding of the Sederhana program. We also thank the consultants of the International Engineering Company, Inc. (IECO), SINOTECH Engineering Consultants, Inc. and the Indonesian firm Sangkuriang, who worked tirelessly and enthusiastically in South Sulawesi and in North Sumatra with the project staff and the team. In long, late night discussions during these field trips they shared with the team unique insights for which we are grateful.

Specifically, we wish to thank the following people who made our work both informative and enjoyable:

Java

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 Dr. Wiryadi, IPB, Bogor
 Mr. Otto Broto Sunaryo, IPB, Bogor
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 Ir. Sumarna, Sangkuriang Consultant, Medan
 Ir. S.T.M. Sihaloho, Consultants' Counterpart, Medan
 Ir. Kursi Sebayang, MOA staff, Jakarta
 Dr. Rudy Sinaga, IPB, Bogor
 Ir. Sormin, Chief of Agriculture, Medan

PROJECT DATA SHEET

1. Country: Indonesia
2. Project Title: Sederhana Irrigation and Land Development I, in support of the Indonesian small-scale irrigation program called the Sederhana Reclamation and Irrigation Program
3. Project Number: 497-0242 (Loan 497-T-037)
4. Project Implementation:
 - a. Authorization--February 28, 1975
 - b. Loan Agreement Signed--June 30, 1975
 - c. Technical Assistance Contract Signed--January 26, 1976
5. Project Funding:
 - a. AID Project \$23.7 million
 - b. Total Project Cost \$59.2 million
 - c. First drawdown against loan--November 1978, for 42.5 percent of the cost of 52 completed subprojects
6. Mode of Implementation: Project Agreement Between AID and the Government of Indonesia (GOI)
7. Evaluations:
 - a. Clive Gray et al., 1978
 - b. AID audit, 1979
8. Purpose:

To decrease dependence on food imports through institution building and increased rice production, thereby improving the well-being of the rural poor through increased income and employment.
9. Accomplishments:
 - a. Target Area: 550,000 hectares (ha) during Repelita II
 - b. Total Covered by June 1980: 150,000 ha
 - c. Total Subprojects Completed or Underway by GOI: approximately 600 (as of June 1980)
10. Host Country Exchange Rates:
 - a. Name of Currency--Rupiah (rp)
 - b. Exchange Rate at time of Project: 620 rp = \$1.00

GLOSSARY

AID	Agency for International Development
BIMAS	Crop Intensification Program -- production inputs supplied on credit (Bimbingan Massal Swa Sembada Bahan Makan)
BRI	Bank Rakyat Indonesia
DGWRD	Directorate General of Water Resources Development of the Ministry of Public Works
FAR	Fixed Amount Reimbursement--method of disbursement of USAID project funds
hectare (ha.)	10,000 square meters or 2.47 acres
IECO	International Engineering Company, Inc.
IFY	Indonesian Fiscal Year, April 1-March 31
Ir.	university graduate engineer
<u>Kabupaten</u>	district government
Major Works	for Sederhana, includes gabion (rock crib) or masonry weir, or free intake, intake and flush gates, primary and secondary canals and associated structures such as division boxes and drop structures
MOA	Ministry of Agriculture
MMT	million metric tons
MPW	Ministry of Public Works
On-Farm Works	tertiary and quaternary canals and structures (does not refer to land clearing)
O&M	operations and maintenance
Repelita	National Five Year Development Plan
Repelita II	April 1974-March 1979, Second Five Year Plan
Rupiah (rp)	Indonesian currency unit, 600 rp = \$1.00

GLOSSARY (continued)

SINOTECH

SINOTECH Engineering Consultants, Inc.

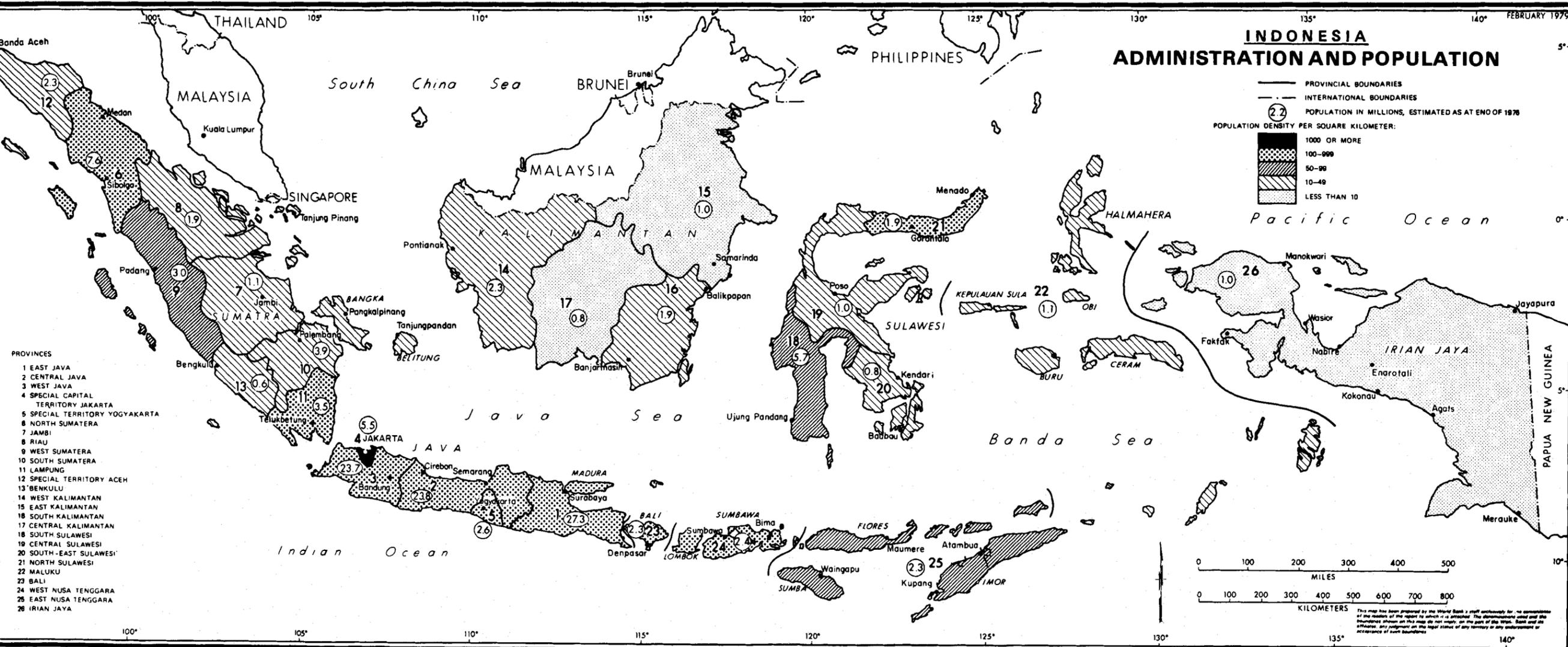
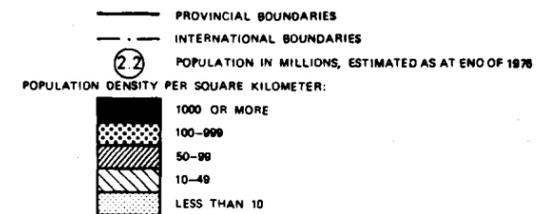
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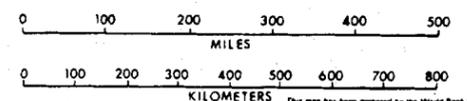
USAID/Indonesia

United States Agency for International
Development, Indonesia Mission

INDONESIA ADMINISTRATION AND POPULATION



- PROVINCES
- 1 EAST JAVA
 - 2 CENTRAL JAVA
 - 3 WEST JAVA
 - 4 SPECIAL CAPITAL TERRITORY JAKARTA
 - 5 SPECIAL TERRITORY YOGYAKARTA
 - 6 NORTH SUMATERA
 - 7 JAMBI
 - 8 RIAU
 - 9 WEST SUMATERA
 - 10 SOUTH SUMATERA
 - 11 LAMPUNG
 - 12 SPECIAL TERRITORY ACEH
 - 13 BENKULU
 - 14 WEST KALIMANTAN
 - 15 EAST KALIMANTAN
 - 16 SOUTH KALIMANTAN
 - 17 CENTRAL KALIMANTAN
 - 18 SOUTH SULAWESI
 - 19 CENTRAL SULAWESI
 - 20 SOUTH-EAST SULAWESI
 - 21 NORTH SULAWESI
 - 22 MALUKU
 - 23 BALI
 - 24 WEST NUSA TENGGARA
 - 25 EAST NUSA TENGGARA
 - 26 IRIAN JAYA



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INTRODUCTION

When the Sederhana Reclamation and Irrigation Program was initiated by the Government of Indonesia (GOI) in 1974, it was viewed as a relatively rapid and inexpensive way to increase food production and rural incomes throughout the country. By improving existing irrigation structures and extending irrigation into new areas, the GOI hoped to achieve a rapid increase in rice production and a corresponding decline in foreign rice imports. The program was part of Repelita II, the second five-year plan for national development (1974-1979).

In 1975, the Agency for International Development (AID) approved a loan to assist the GOI in its rural development efforts. AID support of the Sederhana program was consistent with its mandate in rural development and assistance to the rural poor. The purpose of the AID project, entitled Sederhana Irrigation and Land Development or Sederhana I, was to improve the institutional capacities of Indonesian agencies responsible for administering the program. In 1978, an additional AID project, Sederhana II, was authorized although reimbursement for irrigation structures built under the original Sederhana program was far behind schedule.

By 1980, more than 600 irrigation subprojects were completed or underway. An AID team visited Indonesia in May 1980 to assess the impact of the Sederhana program and the effectiveness of AID assistance.

II. BACKGROUND

A. The Sederhana Irrigation and Reclamation Program

The Sederhana Reclamation and Irrigation Program was one of a long series of efforts by GOI to achieve self-sufficiency in rice production. In 1964, one such effort, BIMAS (Crop Intensification Program), capitalized on green revolution technologies. Using high-yielding varieties of rice, increased fertilizer applications and improved farming techniques, BIMAS succeeded in increasing rice production. Nevertheless, with increases in population growth and in per capita consumption of rice, imports steadily increased.

In 1974, Indonesia imported 1.07 million metric tons (MMT) of rice, approximately 12 percent of the entire international rice market. The bill for rice imports was \$483 million. Although oil exports in 1974 brought \$5.3 billion in revenues, the Indonesian foreign exchange debt totalled \$6.3 billion. The outlook for continued dependence on massive imports of rice prompted the GOI to undertake new initiatives to increase rice production.

The Sederhana program recognized the importance of community irrigation systems and undertook to renovate or construct simple irrigation systems for areas of 2,000 or fewer hectares (ha) and to improve the ability

of local communities to extend, maintain and operate these systems. A total of 550,000 ha were targeted for subproject development.

The official Government statement regarding the program described the proposed irrigation structures as follows:

Generally the structures include a simple diversion weir with a control headgate, unlined main canal, a few secondary and tertiary unlined conveyance ditches, small diversion and turnout structures and a simple means of waste or drainage structures.

The GOI initially budgeted \$31.7 million to finance small-scale irrigation improvements. The Directorate General of Water Resources Development (DGWRD) of the Ministry of Public Works became responsible for implementing the program. Initially, the program planned to upgrade existing irrigation systems. The Sederhana program was viewed as a means of spreading visible physical infrastructure and promoting extension services throughout the country. It was also intended that later, construction of new systems on the more sparsely populated outer islands would encourage the resettlement of Javanese peasants to areas that could support both increased population and increased rice production.

B. The Setting

The varied nature of Indonesia is recognized in its national motto, "Unity in Diversity." As the world's largest archipelago, Indonesia's islands extend over 3,000 miles. They are populated by more than 300 ethnic groups, representing more than 250 distinct languages. Agricultural conditions are also diverse. In Java (and Bali), there are extensive irrigated rice terraces, primarily in the river plains and volcanic slopes. In the outer islands (a name given to the islands other than Java and Bali), topography, soil and rainfall patterns have encouraged more diversified cropping patterns.

In many respects, the development problems of Indonesia have been identified with Java. This small island accounts for 65 percent of Indonesia's population and has a population density of 1,000 persons per square kilometer. Javanese peasants are among the poorest in the world. Many are landless, dependent upon increasingly rare and poor-paying employment opportunities. Others are small landowners with average holdings of less than 0.5 ha. Traditional rice farming on Java uses highly intensive, labor-absorbing techniques. With limited land area for new development, very small farms and increasing population pressure, improved water management is a most pressing need.

The outer islands have remained more sparsely populated. Many have less than 100 persons per square kilometer. Compared to Java and Bali, the outer islands have a more diversified agricultural base, including crops such as coffee, cloves, palm oil and rubber. Although wet rice cultivation has expanded, low population densities and scarce labor limit

its potential. The outer islands were originally coastal kingdoms based primarily on trade. For this reason, they did not develop strong networks with the interior settlements. Today, they lag behind Java and Bali in administrative capabilities. The delivery of health services and education remains inadequate and their relative isolation continues to present an obstacle to development.

III. AID INVOLVEMENT

A. Project Description

AID participation in the Sederhana program began in June 1975, with the authorization of a \$20 million loan that was increased to \$23.7 million in 1976. The AID project, entitled Sederhana Irrigation and Land Development or Sederhana I, aimed to assist the GOI in its efforts to increase food production and improve the well-being of the rural population. The large number of subprojects envisaged and their scattered and isolated locations required a rapid expansion and upgrading of the capabilities of the government agencies concerned. AID's institution-building efforts were focused on the Directorate General of Water Resources Development (DGWRD) in the Ministry of Public Works, and on the Agencies for Rural Irrigation Services and for Agriculture Education, Training and Extension, in the Ministry of Agriculture (MOA).

AID funds were designated for the reimbursement of local construction costs, for technical assistance to project management, for the financing of vehicle procurement, and for the training of GOI personnel. The \$16.5 million set aside for reimbursement of subproject major works construction was not tied to any specific list of projects, but planned to cover Sederhana subprojects scheduled for construction during Indonesian fiscal years 1975-1978. By May 1980, the GOI had more than 600 subprojects underway.

AID funded two technical assistance contractors, International Engineering Company, Inc. (IECO) of San Francisco and SINOTECH Engineering Consultants, Inc., of Taiwan to work with Ministry of Public Works and Ministry of Agriculture officials respectively. IECO provided engineering assistance on construction and was responsible for the certification of completed structures. SINOTECH assisted the Ministry of Agriculture in supervising the construction of on-farm (tertiary and quaternary) irrigation ditches. Through AID's work with the Ministry of Agriculture, attempts were made to organize farmers into water users associations to undertake the cooperative construction, operation and maintenance of the irrigation canals.

In 1978, AID financed a second project, Sederhana II, with a \$25 million loan and a \$4.5 million grant. In general, Sederhana II was designed to continue and extend the work of Sederhana I.

B. Implementation and Funding

Implementation of Sederhana I encountered major delays at the outset. AID efforts to select a technical assistance contractor extended over an entire year. Negotiations with the GOI concerning criteria for selecting subproject areas also took much longer than expected. Finally, overly restrictive language in the loan agreement proved unworkable; the loan was amended to remove the requirement that designs and cost estimates be approved by AID prior to construction.

While AID struggled to resolve these problems, the Directorate General of Water Resources Development (DGWRD) proceeded with the construction of the subprojects. These efforts also encountered setbacks. A major frustration was the inability to complete subprojects within the planned one-to two-year period. Selection, survey and design work were taking one year to complete. The tendering process added several more months.

The Ministry of Agriculture, often uninformed about the construction activities of DGWRD, encountered its own obstacles and was unable to undertake any significant work. Many farmers were unwilling or unable to construct tertiary and quaternary irrigation channels. In any case, this work could not be undertaken until major irrigation channels were completed.

In early 1978, the Government of Indonesia made two major decisions that significantly affected the Sederhana program. First, it declared a clean-up year in order to complete and repair many of the original Sederhana subprojects that already needed improvement. Second, in an effort to speed up the construction of on-farm irrigation channels, the GOI funded the Ministry of Agriculture to construct tertiary canals. (This had previously been the responsibility of benefitting farmers.) As a result of these decisions, improvements were made in approximately one-half of the existing Sederhana subprojects during the 1978-1979 fiscal year. By late 1978, 52 subprojects were completed and AID's loan (Sederhana I) was drawn down for the first time to reimburse approximately 40 percent of the cost of these subprojects.

In spite of these changes, only \$4.3 million of the \$16.5 million allocated by AID for major works construction had been expended by May of 1980. To some extent, the slow rate of reimbursement was due to problems of implementing a new program and other issues discussed above. Also, the fixed amount reimbursement (FAR) method being used by AID to fund the Sederhana program, proved cumbersome. Under this method, a pre-agreed payment for each subproject took place after construction was completed and the new structure was certified to be satisfactory. Since the Sederhana program had hundreds of subprojects scattered throughout the archipelago, certification became a time-consuming, inefficient and cumbersome activity.

AID Mission staff emphasize that the stringent reimbursement criteria have improved subproject implementation by creating higher construction standards. However, more intensive technical assistance at the beginning

of the program might have improved the capacities of the implementing agencies and facilitated the earlier disbursement of AID funds.

IV. FINDINGS

To assess the impact of the Sederhana program, evaluation team members visited 29 AID-assisted subprojects in Java, Sulawesi and Sumatra. The AID team examined impacts on production and employment and assessed the administrative effectiveness of the implementing agencies. Although it was not possible to isolate the impact of the new irrigation systems from other potential influences, the team believes that changes in production and employment were primarily due to Sederhana activities. The evaluation methodology is discussed in detail in Appendix A.

A. Impact on Rice Production

The team found increases in rice production in most of the subproject areas visited. Through the renovation and construction of irrigation structures, the Sederhana program improved water security, facilitated double or triple cropping, and increased yields. In some cases, the program also brought more land under production.

For farmers, improved water security provided a significant change, bringing increased production by preventing or reducing losses. Old irrigation structures broke down frequently. Heavy rains, for example, often destroyed weirs, causing flooding in nearby fields and washing away expensive fertilizers. Under the Sederhana program, improved technologies reduced these kinds of losses. One farmer, when asked about the benefits of the program, replied that he now sleeps much better.

More reliable water supplies also enabled changes in cropping patterns. In the Babana subproject in Sulawesi, for example, the Sederhana program permitted double cropping. Although the number of hectares of irrigated land reached by the subproject remained the same (350 ha.), the amount of water supplied year-round increased. As a result, farmers were able to plant 150 ha. in a second rice crop and still have a third crop of vegetables. Since the average yield of rice in this area is 5 tons per hectare, the subproject resulted in approximately 750 tons of additional rice per year valued at \$320 per metric ton.

The most dramatic production gains occurred as a consequence of converting dry land fields to wet rice fields. When the Blotan subproject in Java was completed, one farmer shifted from cassava and maize production to wet rice production. His annual income increased from 100,000 to 500,000 rupiahs (Rp). Similar gains were recorded by his neighbors and by farmers at other subprojects where dry land fields received irrigation.

Although this change is substantial, the extent of dry land conversion to wet rice fields is very limited. Farmers and village leaders are often reluctant to adopt new cropping patterns even after additional water is

supplied. Their caution results from their experience with unreliable water supplies and their awareness of the potential for social conflict in the management of a finite and fluctuating water supply.

This caution is also evident in the Pvonanggan subproject in Java where an irrigation structure serving 110 ha was extended to include 65 additional hectares. Of the 65 newly irrigated hectares, only ten were planted in rice. The rest were planted in sugarcane, a crop that requires more water than traditional dry land crops, but not as much as wet rice. Since water supplies were plentiful, wet rice cultivation could have been extended to some of the sugarcane fields. However, some landowners strongly objected. Under village traditions, owners of farms closer to the source of water had priority water usage rights when water was in short supply. Extending wet rice cultivation would make their position less secure. Village officials responded to this situation by making gradual changes. Over time, they planned to extend wet rice cultivation to the sugarcane fields, as they acquired experience with the water supply provided by the new system and as farmers gained confidence in its reliability.

Most of the 18 subprojects visited on Java and Sulawesi achieved production gains. Irrigation improvements permitted double or triple cropping on at least some portion of the subproject area. Rice yields increased substantially, as much as 2 tons per hectare. In a few subprojects, dry field crops were replaced with wet rice cultivation, producing dramatic production gains and in a few others, little or no gain was realized. On Java, subproject costs varied from \$138 to \$425 per hectare. On Sulawesi, costs varied from \$23 to \$200 per hectare.

On Sumatra, team members visited 11 AID-assisted sites. In general, these subprojects were larger and more costly than subprojects on Java. Costs varied from \$280 to \$888 per hectare. Many were still in some stage of construction. The use of high yielding varieties of rice was not widespread, and on a majority of sites, farmers were still growing only one rice crop per year.

The potential impact of irrigation on rice production in Sumatra appeared problematic. On several sites, environmental conditions such as soil and climate did not appear favorable for growing rice. Perhaps for this reason, farmers have resisted efforts to convert cash crop land to rice production. Although irrigation was protecting against crop loss and helping to increase yields, efforts directed at double cropping of rice may not be agronomically and economically appropriate on many Sumatra sites.

B. Impact on Rural Employment and Income

In the subproject areas visited, the team found few increases in local employment opportunities in the construction of Sederhana irrigation systems. In some areas, local workers assisted contractors in construction, but in many areas contractors brought their own laborers.

In successful subprojects, double or triple cropping increased labor requirements. The team found that many owner-cultivators used family members for this increased work and hired day laborers only for the most back-breaking jobs. In other cases, landlords offered to sharecrop only the crop of highest risk where labor input would be greatest in relation to projected crop harvest. The Sederhana program has provided relatively few benefit to landless families who are without a stable tenancy situation. For this group, there have been limited opportunities to gain employment income, or increased crops from the new irrigation structures. In general, the landless are brought into the agricultural economy only when harvests are large enough to demand their services.

Landowners have benefitted more than tenants. In some areas land values doubled and even tripled as a direct result of a subproject. When the upgraded irrigation structures were completed, some owners increased rents (shares of crop) paid by tenants. Since productivity also increased rapidly, both the landowner and the tenant realized a net gain. On one Java site, however, landowners chose to resume management of their more profitable fields, turning tenants into day laborers.

For families who owned land, the work load increased, especially for women and girls, who play a predominant role in all aspects of rice production except land preparation. With more land under cultivation and more crops grown each year, women's work has increased, but the harsh conditions of field labor remain the same. In some cases, girls have been taken out of school to meet the increased labor requirement.

In the sites visited, the team found that a relatively small proportion of the increased rice produced was marketed for cash. Increased production was frequently consumed at home or bartered for other food, such as fish. Although the intended increases in cash income were not apparent, these findings suggest that the Sederhana program has improved levels of nutrition in the subproject areas.

The construction and renovation of irrigation structures have not substantially changed land ownership patterns. On Java, owners most often have less than one-half hectare of land, but on the outer islands, holdings range from 1 to 3 ha. The team found equitable land ownership patterns at most project sites. In the province of Yogyakarta (Java), however, village officials received land grants of 2 to 5 ha. in lieu of salary. At one subproject in this province, these land grants accounted for 25 percent of the subproject area.

The relative disadvantage of landless families is most evident on the island of Java where 40 percent of the rural populace is landless, creating an abundant supply of labor. On the outer islands, fewer families are landless and labor is relatively more scarce. The GOI has instituted policies to encourage landless families on Java to migrate to the outer

islands. To the extent that migration and land reform policies enable families to own their own land, opportunities to benefit from the Sederhana program and from other national development efforts will be increased.

C. Administrative Effectiveness

1. Site Selection

Under the Sederhana program, the GOI constructed major works in more than 600 subproject areas. These subprojects were chosen from lists of potential sites submitted by provincial offices of the Ministry of Public Works. In addition to meeting a number of general criteria such as suitable soil and adequate water and labor supply, subprojects of the Sederhana program had to be simple to design and construct, capable of rapid execution and relatively small and inexpensive. Although most of the sites visited by the team appeared to meet the criteria for inclusion in the Sederhana program, the environmental conditions on several sites in Sumatra did not seem favorable for growing rice.

One subproject, Risma Duma, in North Sumatra, illustrated the importance of involving local farmers in the identification of subproject sites. Although Risma Duma was a prosperous coffee-growing region, a Sederhana irrigation system was initiated there in 1976. Local farmers were perplexed by the effort because they did not wish to convert their successful coffee plantations into irrigated rice fields. One farmer commented:

Since you have come here and since the government has already spent a lot of money for this dam, we are prepared to release our land for the irrigation system as long as we receive compensation. However, we swear we are not going to use one drop of water because we don't need it.

The technical assistance consultant for North Sumatra made several attempts to convince the government to abandon the Risma Duma effort. Nevertheless, additional funds were allocated and construction continued. The problems at Risma Duma seemed to result from failure to involve farmers in subproject identification, design and implementation. In addition, feedback systems failed to make needed adjustments as work on the subproject progressed.

2. Major Works and On-Farm Works

One team member inspected irrigation structures at 15 subproject sites (nine in Sulawesi and six in Java). Construction of major works, including diversion weirs and primary and secondary canals, appeared to be proceeding smoothly; most systems were well designed and well maintained. In a few cases, leakage was observed under and around the weirs, indicating a need for better maintenance. Some weirs were badly cracked and crumbling.

Although turnout structures from the main canals to tertiary channels were well built, sometimes they were not being used. At one Sumatra site, 6 of the 14 tertiary structures were not being used. Farmers said they were not built in the right places. At some sites, farmers were diverting water by cutting into the canal. Most of the turnout structures had installed gates that required an unattached handle to operate. Perhaps they were viewed as cumbersome. In any case, farmers preferred to leave the gates open and to regulate the flow by building earth dams or by placing stop logs or rocks under the opened gate.

During the course of the Sederhana program, responsibility for on-farm works underwent several changes. Initially, farmers were expected to build on-farm works. Subsequently, construction of on-farm works, including tertiary and quaternary canal systems, was made the responsibility of the Ministry of Agriculture (MOA). Finally, the initiative was transferred to the DGWRD, in the Ministry of Public Works.

In site visits, the team observed considerable diversity in the construction and operation of on-farm works. A few subprojects had no tertiary canals at all, or tertiaries that were under construction. Other subprojects had tertiaries that were well built and operating. In some areas without tertiary systems, openings in the main and secondary canals were used to allow water to proceed over the area by flowing from field to field. This system did not allow individual farmers to maximize fertilizer applications, but functioned smoothly when everyone was growing wet rice and water was plentiful.

Occasionally, owners were unwilling to make their land available for the construction of new tertiary and quaternary channels. In some communities, landowners were reimbursed to facilitate implementation. In other localities, including the province of West Java, funds were eventually made available to reimburse farmers, but officials were reluctant to do so because no similar provisions were made in previous subprojects.

Some right-of-way issues cannot be resolved by reimbursement. At one subproject on Sumatra, on-farm construction was halted when a farmer refused to give up part of her land for tertiary channels. Team members learned that she owned a very small field and that construction plans would remove almost half of her land from production. The rationality of her position was obvious; without half of her land, the benefits of water were irrelevant.

These and other problems encountered seemed to result from the lack of involvement of farmers in decisions regarding the placement of canals and from insufficient coordination among agencies responsible for construction.

3. Water Users Associations

In addition to constructing irrigation structures, the Sederhana program planned to encourage and assist the development of water users associations to handle the operation and maintenance of irrigation canals,

to discuss cropping patterns and to manage the water supply. Although such associations were integral to the success of the Sederhana program, project records showed that water users associations were formed in only 20 of the first 52 subprojects completed.

Water management systems of the Sederhana program are discussed in detail in Appendix B. In general, site visits suggested that a relatively small number of water users associations were organized and functioning effectively. Water management practices varied, depending on the abundance of the water supply, the previous experience of farmers with the management of irrigation systems and the extension activities of the Ministry of Agriculture. The team also noticed that many water management activities were being refined and that local interest in water management issues was high.

At Sulawesi sites, water supplies were abundant and no systematic efforts were being made to optimize the use of the irrigation systems. On Java, particularly in the province of Yogyakarta, highly sophisticated water management systems were observed. In one subproject, Randugowang, cropping patterns were planned to match water supplies. Water rotation was practiced and fees for water use were assessed. In addition, there was a continuous maintenance program.

Water management practices vary from season to season. During the wet season when water is abundant and rice is the only crop, there is little need for water management. Water is distributed among fields by overland flow rather than in channels. When water supplies are limited, however, operators of an irrigation system have to decide whether to irrigate and where to irrigate. In effect, a system of rationing is initiated. Thus, water management becomes most important to farmers when a limited, but marginally adequate supply of water is available in the dry season. It is only possible if the water conveyance system to each field is in place.

Conversations with farmers indicated that their attitudes change as they gain experience with irrigation systems. Initially, water security is more important than water management. Later, when the reliability of the water supply becomes known, farmers are willing to invest time and labor in the construction of tertiary and quaternary channels, if they perceive that there is enough water in the dry season to make field channels worthwhile. After gaining some experience with field channels, farmers often become interested in water rotation. At this point, strong local leadership appears to be a critical factor for successful water management.

These findings suggest that water users associations have not been given sufficient importance in subproject implementation. Where farmer participation has not occurred, major problems exist. These include failure to adequately ration limited water supplies, failure to equitably distribute water within a small system or among villages in a larger system, the lack of a system for maintaining the physical works, and the inability to prevent illegal water use at unauthorized locations.

Water management is not just an operation and maintenance activity. It is also a planning activity that determines cropping patterns. Water users associations can facilitate increased production, ensure the equitable distribution of these gains and sustain the benefits of the Sederhana program.

V. CONCLUSIONS AND RECOMMENDATIONS

Indonesia in 1980 is, in some ways, not much different than Indonesia in 1974 when the Sederhana program was initially formulated. Oil exports have increased, but foreign debt has doubled. Rice production increased in 1980 to 19 million tons, but population growth offset these gains, and the country imported about 3.6 million tons of grain; the highest level ever. Food self-sufficiency remains an elusive goal and massive imports are still required. In the coming years, food production programs will most likely remain as the central focus of Indonesia's development efforts. It is the conclusion of this team that Sederhana is still a promising rural development program that can make a substantial contribution to Indonesia's development. With this in mind, and based on the review of project documents and the site visits made during the course of this evaluation, the team provides the following conclusions and recommendations:

1. Sederhana has increased production and improved the well-being of the small owner-cultivator in Indonesia. Where the irrigation systems are functioning successfully, they have a significant impact on production, particularly on yields, to a lesser extent, Sederhana systems have increased income and possibly improved nutrition. If siting, design, and farmer participation necessary for successful operation and maintenance can be improved, the program can be a cost effective investment with long term benefits. Rice production is now possible in the dry season. Promoting rice production in areas where it may not be an appropriate crop for the environment, however, has limited the effectiveness of the project. The team suggest that the project purpose be expanded from increasing rice production to increasing total farmer productivity, including the production of other crops. Current subproject feasibility assessments should be improved for selected areas, particularly in the new and largest Sederhana systems. These should focus on soils, water supply and potential cropping patterns, particularly in areas where double cropping of rice may be problematic, or where cash crops may compete with rice.

2. With its many subprojects and schedule for rapid implementation, Sederhana has confronted trade-offs between quantity and quality. The centralized design and approval process permitted rapid and high volume work. However, because designers rarely visited the proposed sites, survey information was often inaccurate, resulting in faulty designs. The team recommends that Sederhana's design process be decentralized to increase input from the provincial level. This should be coupled with a concerted effort to increase farmer participation. The team believes that decentralization would improve the effectiveness of implementation, though it might reduce the number of subprojects which could be undertaken.

3. Farmers view Sederhana as a single system to improve production, but the implementing agencies are concerned with their separate responsibilities. Lack of coordination is a serious constraint and one which cannot be solved simply by additional technical consultants. The team recommends that AID assistance aggressively encourage the coordination of the efforts of implementing agencies.

4. Design and construction problems caused a large number of subprojects to require additional improvement after only a few years. The subsequent shift to a more permanent masonry construction reduced maintenance needs. AID technical assistance also contributed to improving construction quality. Under Sederhana I, technical assistance was insufficient, however, to cover the wide range of subprojects undertaken. In order to meet certification requirements, consultants were often unable to devote sufficient time to transferring skills. As the Sederhana program extends to more remote areas and increasingly marginal lands in the outer islands, technical assistance consultants should be increased and should focus on improving local construction and management skills. On Java, technical assistance should focus on water management issues.

The Sederhana irrigation systems work best in areas where participation of farmers is part of a local tradition. Although a number of water users associations have been formally created under the Sederhana program, farmers are rarely involved in decisions about the new irrigation systems. The team recommends that a plan to broaden farmer participation be developed and implemented. Communication with farmers should begin during the planning stages of each subproject. Topics for discussion include the projected sites for major works and on-farm works, the right-of-way status of lands planned for canal construction, the current cropping patterns, and the benefits of the new or improved irrigation system. As the subproject nears the implementation stage, scheduling should encourage farmer participation in the construction and avoid unnecessary disruption of production cycles. Farmer's participation is the most effective means to ensure productivity and their investment in a system that can only be sustained through their care and skill.

Without baseline data and a system for monitoring and evaluating progress, it is difficult to assess the progress of a project. Currently the size of the area served by the irrigation system is recorded, but size alone does not indicate the adequacy of the water supply or its distribution, or how production levels have changed as a result of the project. The team recommends that simple baseline data be collected in future subproject areas. Information on the type and frequency of crops, yields, disposition of crops and other sources of income, for example, would permit quantification of the impact of increased production on the project's beneficiaries.

APPENDIX A

EVALUATION METHODOLOGY

I. TEAM COMPOSITION

In late May and early June 1980, a four-person team spent three weeks in Indonesia evaluating the impact of the Sederhana program. The evaluation team included three AID officers from Washington (a team leader, an anthropologist, and a water management specialist), and an economist from the AID Mission in Indonesia. (Original plans called for two additional team members. One was dropped in the interest of reducing team size; the other was called away on a medical emergency.)

On arrival in Jakarta, team members discussed the Sederhana program with Mission staff and with the administrator of the program in the Directorate General of Water Resources Development (DGWRD). Subsequently, the four team members separated to spend two weeks visiting subproject sites. One remained on Java and was assisted by a Mission engineer and two Indonesian social science researchers. Two team members travelled to Sulawesi and Sumatra, spending one week on each island and working separately in North Sumatra. They were assisted by two Indonesian AID employees, one an engineer and the other a secretary. In addition, an Indonesian Professor of Rural Dynamic Studies joined the team in Sumatra. The fourth team member, a water management specialist, divided his time between Sulawesi and Java in order to assess similarities and differences in the implementation and impact of the project in these different settings.

II. THE SAMPLE

The team members visited a total of 29 AID-assisted subproject sites in four provinces: West Java, Yogyakarta, South Sulawesi and North Sumatra. Nine subprojects were on Java; nine were on Sulawesi and eleven were on Sumatra. Sites visited are listed in Table A-1 with pertinent information concerning their status and progress.

Subprojects visited were fairly representative of completed subprojects on Java and the outer islands visited. Most were rehabilitations of previous irrigation systems, thus reflecting the early emphasis of Sederhana efforts. The subprojects visited were, however, the most mature of the Sederhana program. This may introduce a bias toward the more successful efforts because many had been improved more than once during the previous five years. Also, subprojects visited were generally accessible by a major road. More remote subprojects and the large new areas targeted for resettlement and irrigation (especially on Kalimantan) were not included.

III. APPROACH

The team decided that the impact of the Sederhana program and the effectiveness of AID participation in it could best be assessed by looking

at results such as production increases, the ability of implementing agencies to administer the program, and the quality of construction. The approach combined extensive interviews with farmers on the outer islands with more in-depth interviews with a smaller number of farmers on Java. Thus, the team's intensive work concentrated on Java where there is a long tradition of rice farming and where subprojects were more mature. These areas were considered more likely to reveal problems in water management as well as possible solutions.

Although the team focused primarily on issues related to the impact of the program, questions concerning administrative effectiveness were also examined. AID-assisted project management by providing training and technical assistance to the implementing agencies (DGWRD and MOA). The team assessed the technical competence of these institutions by examining the quality and effectiveness of the irrigation systems, the agencies' ability to respond to problems, and the coordination of activities in the two ministries involved. Specific attention was also directed to the effectiveness of communication with farmers in the subproject area.

IV. INFORMATION COLLECTED

In the areas visited, team members met with many provincial directors and other personnel from both DGWRD and from the Ministry of Agriculture. Team members also conducted informal interviews with farmers. The following topics served as a guide:

- Cropping patterns (what kind, how often, differences from five years ago);
- Water (how much, when, comparison of wet and dry seasons, who determines use);
- Irrigation system (does it work well, canal placement, reliability of water, maintenance, water delivery capability in wet and dry seasons, rotation of water, how problems are solved, who decides distribution);
- Production/Yields (last crop, what was it, yield per hectare, how many crops per year, what kind);
- Inputs (use and effectiveness of fertilizer, pesticide, and credit, costs of inputs on time, agricultural extension);
- Marketing/Prices (what is done with crops, who buys, how much, where);
- Income (from crops sold, other sources, farmer and other family members);
- Consumption (how much of crop consumed by family, comparison with preproject period, other purchases with income);

- Tenancy (terms of land ownership, amount of crop to pay for tenancy, day labor wages for different jobs in production cycle, changes since the project began); and
- Employment (is there more work, what kind, who does it, are there new jobs, what kind, seasonal or year round, payment for work by type).

In assessing impact, changes in production were attributed to the irrigation activities of Sederhana. No attempt was made to isolate the benefits of irrigation, but it was assumed to be a primary cause of increased production. Another program designed to increase production (BIMAS) was in place before Sederhana began.

In addition to information obtained through meetings and informal interviews, data were gleaned from AID project files, from the records of the Government of Indonesia ministries at the provincial level and from various reporting instruments of the technical assistance contractors.

Table A-1. Status of Sederhana Subprojects Visited in Java, Sulawesi and Sumatra, June 1980

Subproject Name	District	Total Area (ha)**	Major Works			On-Farm Works		
			IFY*** Started	Target Area (ha)	Percent Completed	IFY Started	Target Area (ha)	Percent Completed
<u>Java</u>								
Cimpcuny	Bagor	150	76/77	150	100	76/77	106	--
Cikalong	Sumedang	472	76/77	472	100	76/77	74	100
Cinangka	Sumedang	187	77/78	187	100	--	122	--
Harikukun	Cianjur	83	77/78	83	100	--	--	--
Leuwi Jubleg	Cianjur	319	78/79	319	100	--	--	--
Blotan	Sleman	110	76/77	70	100	76/77	70	100
Randugowang	Sleman	74	76/77	58	100	76/77	74	100
Tuk Suluh	Gunung Kidul	104	76/77	104	100	76/77	96	100
Pvonanggan	Sleman	170	77/78	170	100	--	170	20
<u>Sulawesi</u>								
Kariu I	Bantaeng	432	76/77*	432	100	76/77	375	100
Panaikang II	Bantaeng	369	76/77*	369	100	76/77	150	89
Kariu II	Bantaeng	185	76/77*	185	100	76/77	113	100
Cakura	Takalar	731	76/77	731	100	76/77	--	--
Babana	Bulukumba	413	76/77*	413	100	76/77	300	83
Biang Loe II	Bantaeng	148	77/78*	148	100	77/78	--	--
Bon Tomanai	Gowa	326	75/76	--	--	--	--	--
Tino I	Jeneponto	400	74/75	--	--	--	--	--
Leang-Leang	Maros	640	77/78	--	--	--	--	--
<u>Sumatra</u>								
Aek Mandosi	Tapanuli Utara	852	76/77*	49	100	76/77	213	35
			77/78*	227	100	77/78	--	--
Bukit Cermin	Deli Serdang	532	76/77*	182	100	76/77	403	100
			77/78*	341	100	77/78	--	--
			78/79	--	100	--	--	--
Namu Embilin	Langkat	200	76/77	87	100	76/77	74	100

Table A-1. Status of Sederhana Subprojects Visited in Java, Sulawesi and Sumatra, June 1980, cont'd

Subproject Name	District	Total Area (ha)**	Major Works			On-Farm Works		
			IFY*** Started	Target Area (ha)	Percent Completed	IFY Started	Target Area (ha)	Percent Completed
Kuala Janji	Simulungun	1155	76/77*	310	100	76/77	171	100
			78/79	845	100	--	--	--
Aek Simare	Tapanuli Utara	395	76/77	--	100	76/77	366	40
			77/78*	395	100	77/78	--	--
			78/79	--	100	--	--	--
Lumban Gaol	Tapanuli Utara	217	76/77*	114	100	76/77	161	40
Paya Lah-Lah	Tanah Karo	1500	76/77*	500	100	76/77	--	--
			77/78*	600	100	77/78	--	--
			78/79	400	100	--	--	--
Risma Duma	Tanah Karo	1200	77/78	500	100	77/78	--	--
			78/79	165	70	--	--	--
Purwaganda	Simalungun	200	78/79	--	100	--	--	--
Janji Meriah	Tanah Karo		--	--	--	--	--	--
Berastepo	Tanah Karo		--	--	--	--	--	--

Source: Contractor's records. For some subprojects, certain information was unavailable.

* Subproject has been reimbursed.

** ha = hectares 1 hectare = 10,000 square meters = 2.47 acres

*** IFY = Indonesia Fiscal Year, April 1 - March 31

APPENDIX B

THE SEDERHANA IRRIGATION AND WATER MANAGEMENT SYSTEMS

by

G. L. COREY

I. BACKGROUND

The Sederhana Irrigation Program was proposed in 1974 to increase food production in Indonesia. The program was initiated by the Government of Indonesia (GOI) prior to AID involvement.

A major characteristic distinguishing this program from other irrigation projects in Indonesia was the simple nature of the projects to be undertaken. Projects were visualized as simple to design, simple to construct, capable of rapid execution and relatively inexpensive. The projects were expected to quickly increase rice production.

Sederhana projects were planned as a transitional phase in the
Previous Page Blank e water resources of a particular area. They were de-
ucted in the simplest practical way in order to spread
-----to agricultural land as quickly as possible. All projects
were gravity fed without provision for water storage. In most cases,
diversion from the river was achieved through use of a structure (weir)
that was placed in the river at the canal outlet. Early projects used the
gabion weir as the diversion structure, but excessive maintenance require-
ments later led to the installation of more permanent masonry structures.
All projects have a controlled inlet structure at the headworks of the
canal.

No feasibility studies were required. Several easily assessed criteria were used to select project sites. Hydraulic design was based primarily on reconnaissance and topographic surveys with a minimum of detailed site information. System success was therefore based on several implicit assumptions, including:

- that river flow was adequate;
- that the expected life of structures was sufficient to economically justify construction; and
- that for the total project, the ratio of benefits to costs was positive.

The size of the completed systems varies considerably from less than 50 hectares (ha) to as many as 2,000 ha. Most systems are less than 300 ha in size. All systems depend on the run of the river, having essentially no active storage capacity. The physical system includes a weir (diversion dam), a headworks canal inlet structure, primary and secondary canals to transport water throughout the irrigated area, and tertiary and quaternary channels that take water from the primary or secondary system and deliver it to each farm. Related structures within the distribution system include

bridges, culverts, drop structures, chutes, canal linings, division boxes, headgates and farm turnouts.

The following information is based on a study of project planning documents, project files, and field visits to nine projects in South Sulawesi and six projects on Java. In most cases the entire main canal system was inspected.

II. IRRIGATION SYSTEMS

Many irrigation systems replaced and extended an existing older system. As a result, reasonable channel alignment and proper location of structures was greatly facilitated. Some systems were constructed and subsequently rehabilitated within the six-year project life, suggesting that the simple design and construction methods have often been inadequate. Gradually the program is improving design and construction techniques and increasing the expected life of the physical irrigation system.

Unit costs of the systems inspected vary considerably depending on construction needed. Of the 29 sites visited, costs varied from roughly Rp 15,000 per hectare (\$10 per acre) to Rp 466,000 per hectare (\$300 per acre) with the overall average being Rp 165,000 per hectare (\$106 per acre). These costs only include the physical distribution system and related structures and do not include technical assistance and administrative costs. However, they are quite reasonable when compared internationally with costs of constructing and rehabilitating irrigation systems.

Most permanent structures are masonry constructed with concrete plaster. This type of construction is common throughout most of Indonesia because cement and rocks are plentiful. It does, however, require regular maintenance, especially on weirs that are subjected to high velocity flows during flood periods. Such flows ordinarily carry a high bed load of silt and sand sediments as well as gravel and large rocks.

Many early weirs were constructed of rock crib (gabion) and some have masonry wing walls with gabion crests. These require more maintenance because high flows eventually break the wire meshing and gouge out rocks from within the cribs. Apparently most weirs are now being constructed using masonry throughout.

Most weirs were well designed and suitably located, with sluice gates to remove sediments from the upstream side. Many of the sites visited needed maintenance to repair eroded patches. Annual inspection and maintenance during low river flow periods should be standard practice. Some leakage under and around weirs was observed but in no case were these as yet serious. In one case (Blotan-Yogyakarta), siting did not appear appropriate; the weir had been placed very close, if not upon, a flowing spring.

All canal headworks observed were well designed and constructed with control gates. Generally, the upper portion of the canal had a sluice gate to permit periodic flushing of sediments from that portion of the canal. In two cases (Blotan and Nglengkong) the flushing operation was taking place during the visit.

Other major structures along the canal system are of masonry construction. Generally, they are well built. However, compaction often occurs behind wing walls, causing walls to crack throughout the depth of the wing. In structures observed, this was not yet causing any serious problems.

Turnout structures from the canal to tertiary channels, although well built, sometimes were not being used. At several South Sulawesi sites, farmers were diverting water from the canal at a site near but not at the structure. Apparently, some tertiary and quaternary systems were designed from topographic maps, without input from farmers as to appropriate design or location. Most tertiaries had gates that were not being used. Farmers left the gates open and regulated flow by building earth dams or by placing stop logs or rocks under the opened gate. Perhaps the screw type gates that require an unattached handle to operate were considered cumbersome to operate. On one non-Sederhana site visited (Blimbing) farmers were observed using gates even down to the quaternary channels. On this site, the gates were small and easily operated and had been constructed and installed locally.

Most main and secondary canals observed were in good repair. Many had been recently constructed and were perhaps too new for maintenance problems to have developed. Earthen canals on flat slopes need more frequent maintenance because low velocities permit excessive weed growth. On South Sulawesi, some earthen canals needed repairs but no maintenance program was apparent. Systems in the Yogyakarta province, on the other hand, were obviously well maintained and farmers were seen cleaning and repairing the channels.

Great diversity was observed in the design, construction and operation of the tertiary and quaternary systems that bring water from the canal to the farm and field level. Systems varied from having no tertiaries in evidence, to having tertiaries under construction, to having well-built and operated tertiaries extending to each farm. Some of the variation may be due to age of the systems or the degree of sophistication of the water users associations managing the systems. It probably also reflects the evolution of methods used to get the tertiary/quaternary system in place. Initially farmers were expected to build on-farm works. Later the Ministry of Agriculture (MOA) provided assistance to farmers (Rp 5,000 per hectare). Subsequently funding was increased (Rp 50,000 per hectare). Finally, the entire canal system including the on-farm works was designed and built by the Ministry of Public Works.

Where no tertiary system was being used, water was supplied through openings in the main and secondary canals and proceeded over the area by flowing from field to field. This system was tolerable where everyone was

growing wet rice and there was plenty of water. It would not permit the growing of upland crops within the overland flow system.

In cases where the tertiaries were under construction or at least not complete (South Sulawesi), farmers were often getting water by breaking the canal banks at many locations and having the water flow from paddy to paddy. At three sites in South Sulawesi (Kariu I, Cakura and Tino I) tertiary structures (division boxes and drop structures) were being built with MOA assistance. In general the quality of the masonry construction appeared to be lower than the quality of main system structures. (This appearance may be due to the fact that concrete facing had not yet been installed.) In a few cases, the structure seemed to be poorly situated. One was built at least 30 centimeters too high. Construction supervision of these tertiary structures may be inadequate.

Highly sophisticated tertiary and quaternary systems were noted in Yogyakarta. Maintenance of these channels was excellent. Rotation of water was being practiced and in some systems virtually no water was being wasted anywhere within the project area. One system, Randugowang, was especially impressive. It had a well-organized farmer organization. Cropping patterns were planned to match water supply. Water rotation was being practiced. Water charges were made and there was a continuous maintenance program. Farmers were using their own funds and labor to line quaternary channels. One would be hard pressed to find a better-managed irrigation system anywhere in the world.

On most systems observed, the on-farm paddy terracing was constructed prior to the project. The quality of these terraces depends on farmer experience. In Java, farmers are able to construct and maintain rather large terraces that are extremely level.

III. WATER MANAGEMENT SYSTEMS

In water management terms, the Sederhana program cannot be discussed as a project. It is a set of several hundred projects and each one has distinct characteristics (physical, social, and political) that set it apart. Among the 15 projects visited by the water management specialist on the team, water management varied from excellent to poor.

The extensive variation in conditions affecting water management makes the Sederhana program worth careful study. Small-scale irrigation projects of the type being built under this program are becoming increasingly popular in the developing world because of escalating energy costs and the international emphasis on small, poorer farmers. Since experience with small-scale systems is limited, a program such as Sederhana with over 600 individual projects can provide information and guidance to future efforts elsewhere in the developing world.

In evaluating the effectiveness of water management within specific projects, it is important to recognize the constraints of run-of-the-river irrigation systems. First, the quantity of water available is totally dependent on river flow and is neither constant nor predictable.

Cropland irrigated by a run-of-the-river system is subject to the volume and timing of that river's flow over the course of the year. River water is diverted from its normal course to irrigate crops. Given the monsoon climate of the Indonesian archipelago, river flows tend to be highly seasonal, varying from torrents to trickles in a few weeks time. There is no storage basin or structure to store water in most Sederhana systems. Irrigation under these circumstances can spread water to lands where it was not available before. It can intensify water use in existing systems, and reduce the risk of crop failure. However, all irrigation activities depend upon the total supply and temporal constraints of the existing river. Water cannot be applied if it is not available in the river. Sederhana therefore serves two important purposes: it supplies water during the dry season, if available; and it acts to protect the monsoon rice crop from unseasonal variations in the rains.

Irrigation systems supplied by the run of the river have complicated water management systems. The water supply is variable and not readily predictable. Therefore, farming under them is similar to operating in a dryland system where crop husbandry is dictated by precipitation patterns. Cropping patterns must be matched with available water supply in order to optimize production. Since the supply is subject to rainfall and run-off patterns, farmers must learn, over time, how to optimize production. Periods of lower flow can be optimized in at least two ways (by leaving some land idle and by planting less water demanding crops on some of the land). Thus, the Sederhana production system optimization should not be expected to occur immediately; rather one should expect gradual increases over time as management matures.

A second constraint of the Sederhana systems is the fact that the seasonal demand for irrigation water does not match the supply. In fact, the opposite occurs; when demand is high the supply is low.

Rice is the principal crop grown in most areas during the rainy season. During that period the irrigation system acts as a supplemental supply to the natural rainfall. Neither the quantity of water available nor the sophistication of the water management system is critical at this time. In other words, when water is plentiful, its management is not a problem in a rice system because excessive water does not harm rice.

The Sederhana irrigation systems are designed to carry sufficient water for rice in the dry season. However, during the dry season the discharge is most often determined by the flow in the river. In some cases it is apparent that dry season flow is negligible; in others, dry season flow is more reliable.

Therefore, there is a great deal of variability among the Sederhana systems. Some systems are restricted to wet season use only, while others have access to design discharge throughout the year. Of course, there are also numerous systems between these extremes. The farmers must learn the reliability of their system before they can optimize production. In most cases, dry season flow is below design capacity and drought-resistant crops are grown.

For this reason, cropping patterns vary considerably during the dry season. Some Sederhana systems are planted almost totally to rice (reliable river flow) while others are not being farmed (no river flow). Most systems are somewhere between these extremes and are planted to varying amounts of vegetable crops and rice.

If the irrigation system does not operate during the dry season, there is little need for a sophisticated water management system because when water is plentiful in a rice system it really doesn't matter whether or not it is equitably distributed.

A third constraint of the Sederhana systems is the fact that local water users organizations do not make all water management decisions. Water management is a complex process by which water is distributed among villages, among farms, and on farms. Much planning is necessary to optimize water use among a group of farms. Also, the system must be maintained as planned.

In the planning process, decisions must be made concerning what crops to plant and where to plant them. This is especially important when water is scarce. Rice typically uses at least twice as much water as most other crops. When water is limited, good management calls for mixing less water demanding crops with rice in a proportion that will optimize the use of water.

In Indonesia, village leadership is not usually responsible for water users associations. However, the village leadership often decides cropping patterns. Therefore, one of the important factors affecting water use and management is not being planned by water users associations.

When an irrigation system is extended to cover more area, as has been the case in many Sederhana projects, planners must work out a schedule of use so each farm gets a "fair" share. Traditionally the better right (bigger share) was given to the farmers operating on the original system. However, since the old system is no longer in existence, it could be argued that everyone should have equal rights. Regardless of how rotation schedules are worked out, this water management issue complicates optional use of water and creates the need to give farmers time to work out the best solution.

Given the above constraints it is obvious that even though the irrigation system may be simple in all respects, the water management system is not simple in any respects. Several water management practices,

observed in the field, reflect the degree of sophistication of some water users associations. In one system, water was reused by diverting waste and drainage flows back into the main system. In another area, all the water available was used for a time in one locality and then rotated to another area on a fixed schedule. A subproject in Java pumped water from a well to extend its irrigation system. Elsewhere, farmers were growing vegetables on the dikes that surround rice fields, growing rice without maintaining continuous standing water in the plot (Java), and growing less water demanding crops in the dry season and in areas where water supplies were not reliable. At one subproject site, water was controlled sufficiently so that vegetable crops could be grown in a plot surrounded by rice fields. Finally, one enterprising community made arrangements with a sugar company to finance construction of tertiary channels.

In short site visits, it was impossible to understand and assess the water management rules, regulations and practices in place. Some systems seemed to have very loose organizations while others were surprisingly sophisticated. It should be noted that every irrigation system that serves more than one farmer requires some type of organization even though it may not be formalized. No group can share a resource without some planning and process of control.

One of the water management systems observed involved dividing the subproject area into blocks and electing or appointing a farmer to make sure that water is used and shared within the blocks according to pre-arranged rotation and use schedules.

In other areas, the village leadership organizes and implements cropping patterns according to anticipated water supplies. Some water users associations levy charges for water (Rp 100 per irrigation) when it is scarce enough to create a rotational situation. Funds are used to improve the system.

When a systematic water management effort does not exist, it may reflect either a system that only has significant water flow during the rainy season or a system in which farmers are unaware that the wet season can be extended by manipulation of the irrigation and cropping systems.

The Sederhana program provides excellent opportunities to learn how to improve the development and operation of small-scale irrigation systems. As yet, no formal mechanism exists for sharing the lessons learned by the numerous subprojects. Better water management could significantly increase production.

One of the problems associated with both the irrigation and water management systems is the design, construction and operation of the tertiary/quaternary system. Some projects have no system at all while others have sophisticated, carefully managed and well-maintained systems that deliver water to each field on the project.

Improvements could also be made in water management organizations. Both the tertiary/quaternary system and the water management organization must be operating well before production can be optimized.

Improvements in both areas could be made by the development of a better system of design, construction and operation for tertiary/quaternary systems. This should be done by choosing pilot project areas and working closely with concerned farmers and village organizations to develop procedures and methods that can be adopted by the Sederhana program. Farmers must be involved in this process. The experiences of presently operating projects could be helpful. Many lessons are being learned within the program, but no system exists for using or even recognizing them. By devoting extra effort and funding in this area, the Sederhana program could facilitate improvements in water management practices throughout the country.

APPENDIX C

LOGICAL FRAMEWORK MATRIX

SEDERHANA (SIMPLE) IRRIGATION AND LAND DEVELOPMENT PROJECT

<p>I. A. <u>Program or Sector Goal</u> Decrease Indonesia's dependence on food imports, particularly rice, needed to feed growing population.</p>	<p>B. <u>Measures of Goal Achievement</u> 1. Value of food imports per year. 2. Tons of rice imported per year.</p>	<p>C. <u>Means of Verification</u> GOI trade statistics.</p>	<p>D. <u>Assumption for Achieving Goal (Targets)</u> 1. Present conditions of political stability continue to prevail. 2. GOI's Family Planning Program meet their targets. 3. Other GOI food production programs meet their targets. 4. Transportation and marketing system capable of moving rice from producers in surplus areas to consumers in deficit areas, both intra- and inter-island.</p>
<p>II. A. <u>Project Purpose</u> 1. <u>Institution Building (Primary Focus)</u> Increase in institutional capability of GOI implementing agencies; particularly the: (a) DGRWD; (b) Provincial Public Works offices; (c) Agency for Agriculture Education Training and Extension; (d) Rural Irrigation Service; and</p>	<p>B. <u>Conditions that Will Indicate Purpose Has Been Achieved— End of Project Status</u> 1. <u>Institution Building</u> Successful implementation of Sederhana Program at level about 60,000 hectares in IFY 1976-77.</p>	<p>C. <u>Means of Verification</u> 1. <u>Institution Building</u> GOI computerized program progress control system and AID monitoring of this system.</p>	<p>D. <u>Assumptions for Achieving Goal</u> 1. <u>Institution Building</u> a. End-of-project and ultimate purpose. Adequate number of technical personnel available to implement Program at target levels.</p>

(e) Provincial Agriculture Services; to implement primarily GOI's Sederhana (Simple) Irrigation Program the amount necessary to achieve a program level of about 60,000 hectares in IFY 1976-77 and even greater program levels in subsequent years.

b. Ultimate purpose. Momentum generated during implementation of AID project maintained in subsequent years.

2. Rice Production

Increase rice production from subproject areas by about 101,000 tons in IFY 1978-79 and ultimately by about 211,000 tons in IFY 1984-85.

Note: Secondary crop production may also be increased.

2. Rice Production

- a. Increased rice production from subproject areas of about 101,000 tons in IFY 1978-79.
- b. All major works serving each subproject area in place and operational.
- c. 40 percent of area of each subproject dependably irrigated and capable of producing paddy rice.

2. Rice Production

- a. Department (Ministry) of Agriculture rice crop statistics.
- b. GOI computerized program progress control system and AID monitoring of this system.

2. Rice Production

- a. End-of-Project and ultimate purpose.
 - 1) Rice and input prices kept at level adequate to maintain farmer incentives.
 - 2) BLMAS production input package provided to farmers tilling following percentages of subproject areas in indicated year after completion of major works:

- a) one- 0%
- b) two- 15%
- c) three-35%
- d) four- 55%
- e) five- 60%
- f) thereafter-60%

b. Ultimate purpose.
Tertiary canals and farm service ditches serving remaining 50% of area of each subproject completed after AID Project completed.

3. Well-being of Rural Poor

- a. Increase income of farmers in subproject areas by about \$210 per hectare in IFY 1978-79 and ultimately by about \$270 per hectare in IFY 1984-85.
- b. Increase employment opportunities in subproject areas in:
 - 1) Construction by about 84,000 man-years in IFY 1975-76 and 108,000 man-years in IFY 1976-77.
 - 2) Tilling land in:
 - a) Wet season by about 97,000 jobs in IFY 1978-79 and ultimately by about 179,000 jobs in IFY 1984-85.

3. Well-being of Rural Poor

- a. Increased income of farmers in subproject areas of about \$210 per hectare.
- b. Increased employment opportunities as indicated for IFY 1978-79 under project purpose.

3. Well-being of Rural Poor

GOI computerized program progress control system and AID monitoring of this system.

3. Well-being of Rural Poor

- End-of-Project and ultimate purpose.
- a. Rice and input prices maintained at level adequate to generate increases in farmer income indicated under project purpose
- b. Present average size of land-holding in subproject areas of one hectare or less of paddy maintained.
- c. Implementation of subprojects carried out in labor-intensive manner.

- b) Dry season by about 29,000 jobs in IFY 1978-79 and ultimately by 59,000 jobs in IFY 1984-85.
- 3) Operation and maintenance by 4,400 person-years per year.

III. A. Outputs

- 1. Institution Building
 - a. GOI implementing agency counterpart personnel assisted and trained by consultants.
 - b. Establishment of internal training programs in GOI implementing agencies
 - c. GOI implementing agency personnel completing training programs:
 - 1) In-country
 - 2) Overseas
- 2. Rice Production
 - a. Major works (weir, primary and secondary canals, major structures, etc.)
 - b. Water user associations.
 - c. Extension activities.
 - d. Water user association offices.

B. Magnitude of Outputs

- 1. Institution Building
 - a. Number of GOI implementing agency counterpart personnel assisted and trained by consultants.
 - b. Internal training programs established in GOI implementing agencies.
 - c. Number of GOI implementing agency personnel completing training programs:
 - 1) In-country
 - 2) Overseas
- 2. Rice Production

IFY 1975-76 subprojects covering about 50,000 hectares and IFY 1976-77 subprojects covering about 60,000 hectares located in 23 of Indonesia's 26 provinces and special areas.

C. Means of Verification

- 1. Institution Building

AID monitoring.
- 2. Rice Production

GOI computerized program progress control system and AID monitoring of this system.

D. Assumptions for Achieving Outputs

- 1. Institution Building

None
- 2. Rice Production
 - a. Ministry of Interior able to provide land certificates to farmers in subproject areas without AID assistance.
 - b. Bank Rakyat Indonesia (BRI) able to provide

- e. Land certificates.
- f. Finished rice paddies ready for planting.
- g. Tertiary canals and farm service ditches serving 40 percent of area of each subproject.
- h. Effective water management.
- i. Adequate operation and maintenance (O&M) of:
 - 1) Major works
 - 2) Tertiary canals and farm service ditches.

- required medium-term credit for land clearing, leveling and paddy forming to farmers in subproject areas without AID assistance.
- c. Ministry of Transmigration and Cooperatives able to provide required transmigrant farmers and construction workers in subproject areas without AID assistance.
- d. Adequate financing provided for O&M.

IV. A. Inputs

- 1. Institution Building
 - a. Long-term consultants.
 - b. Short-term consultants.
 - c. Training:
 - 1) In-country
 - 2) Overseas

B. Implementing Target (Type and Quantity)

See Annex B.2, Tables 21 to 25 for detailed breakdown of inputs by quantity, cost, implementing agency, AID financing category, source of financing and time phasing.

C. Means of Verification

- 1. Traditional Direct Procurement. AID monitoring.
- 2. Fixed Amount Reimbursement, GOI Contribution, and Farmer Contribution. GOI computerized program progress control system and AID monitoring of this system.

D. Assumptions for Providing Inputs

- 1. Institution Building
GOI makes budget provision for and provides its inputs on timely basis.

2. Institution Building and Rice Production
- a. Gabion wire.
 - b. Light equipment.
 - c. Hand tools.
 - d. Hydrology equipment.
 - e. Maintenance support light equipment and hand tools.
2. Rice Production
- a. GOI makes budget provision for and provides its inputs on timely basis.
 - b. Farmers provide their inputs on timely basis.

3. Rice Production
Funds for:
- a. Survey and design of major works and tertiary canals.
 - b. Construction of major works and tertiary canals.
 - c. Formation of water user associations and extension.
 - d. Construction of water user association offices.
 - e. Issuance of land certificates.
 - f. Land clearing, leveling and paddy shaping.
 - g. Construction of farm service ditches.
- Plans for:
- a. Water management
 - b. O&M of:
 - 1) Major works.
 - 2) Tertiary canals and farm service ditches.

APPENDIX D

AID AUDIT REPORT

Area Auditor General/East Asia

The following report presents the findings of an AID audit of Sederhana I and Sederhana II conducted in September 1979. The report has not been extensively edited. It is included because it provides additional insights on the Sederhana program.

I. EXECUTIVE SUMMARY

As part of the regular review of the USAID/Indonesia program the Area Auditor General/East Asia (AAG/EA) conducted an audit of the Sederhana Irrigation and Land Development I & II Projects (Nos. 497-0242/0252).

The projects are financed by a combination of grant and loan funds. Project 497-0242 is loan funded with \$23.7 million, Project 497-0252 is receiving \$25.0 million and \$4.5 million, from loan and grant sources respectively. Total project financing to date amounts to \$53.2 million.

The project's purpose is to assist in the development of small-scale irrigation systems throughout the Indonesian archipelago. Immediate benefits are measurable in terms of millions of construction employment days for Indonesia's rural poor, while the longer-range benefits are expected to bring about significant income improvements for at least 800,000 farm family members. The AID funds are used to:

- offset local construction;
- provide training for Government of Indonesia (GOI) personnel;
- finance vehicle procurement; and
- provide technical consultants.

Overall, Sederhana is one of AID's most ambitious programs in Indonesia, while at the same time being responsive to the Congressional Mandate of meeting the Basic Human Needs of the least self-sufficient rural part of the population.

II. AUDIT PURPOSE

The purpose of our audit was to determine, as of September 30, 1979, whether the project as designed and implemented is achieving predetermined goals; management of the project is effective; and AID-provided resources are being utilized in accordance with USAID regulations.

III. CONCLUSIONS AND RECOMMENDATIONS

We concluded that in general the Sederhana program was achieving pre-determined goals, was being effectively managed, and AID-provided resources were being utilized in accordance with USAID regulations.

Noted below, however, are certain areas in this complex and widely geographically disbursed undertaking where additional actions would further enhance the program's implementation.

For implementation as well as loan reimbursement purposes, the irrigation systems are divided into two categories: "major works" and "on-farm works", with "major works" representing the construction of dams and primary/secondary canals, and the "on-farm works" the tertiary canals and ditches required within the system to distribute the water to the farmers' fields. USAID's initial reimbursement for local construction costs for many of the 52 completed "major works" subprojects contained supporting documentation that qualified the satisfactory performance aspects of the work. Further, in several of these completed subprojects, the amount of reimbursement had not been computed in accordance with established formula. Full utilization of the "major works" component of many subprojects is dependent on the "on-farm works" portion. "On-farm works" progress has been limited and USAID needs to develop a synchronized time frame plan for completion of these subprojects. At the same time a reimbursement formula for "on-farm works" has yet to be developed. The USAID felt that we had overstated the negative aspects of the limited progress on the "on-farm works."

Although considered an essential element in the successful operation and maintenance of small irrigation systems, few water users associations have been organized. The preparation of an operations and maintenance plan for the "major works" has yet to be finalized. Also funds provided by the GOI for operation and maintenance of the completed irrigation systems appear to be inadequate. An effective evaluation system has not been developed to monitor the Sederhana program. The program's rate of implementation is not accurately measurable in terms of conventional financial data. This is due to a large extent to a major funding component being financed under the fixed amount reimbursement (FAR) method whereby payment takes place only upon completion and final acceptance of construction work by AID.

USAID, in response to our draft report, expressed concern that as an overall management analysis our review had failed to achieve its purpose. The USAID in this respect stated:

While it is true that in terms of records and history the 52 subprojects which had been reimbursed at the time of the audit potentially provided the most information, Sederhana at that time comprised over 750 subprojects. Yet the vast majority of the auditor's comments and factual data focus on about 7 percent of

Sederhana subprojects. The increasing role and importance of technical assistance has resulted in an overall subproject quality which is higher than the initial group.

We believe that the nature of our findings with regard to the 52 subprojects that had been reimbursed at the time of our audit, unless acted upon, will continue to exist as other subprojects are completed and become eligible for reimbursement. The 52 subprojects have added significance to us as they represent completed activities which AID has financed.

IV. SCOPE

Our audit covered the period from March 1, 1976 to September 30, 1979 and focused on issues to determine whether:

- the project as designed and implemented is achieving predetermined goals within established time frames;
- management of the project is effective; and
- AID-provided resources are being utilized in accordance with USAID regulations.

The report findings have been discussed with Mission officials in draft form and their comments considered in the preparation of this report.

Our prior review of this program was part of a comprehensive audit of USAID/Indonesia activities in 1976 and produced no recommendations.

V. BACKGROUND

USAID/Indonesia's participation in the Government of Indonesia's (GOI) Sederhana program represents one of its first attempts to meet the Congressional Mandate to help the rural poor majority. The relatively small-scale unsophisticated irrigation systems to be either constructed or renovated under the project are to provide an ample supply of water to farmers on a regular basis. Each individual community irrigation system, when complete, will provide for its own operation and maintenance service.

AID investment in the Sederhana program began with a \$20.0 million loan in 1975 which was raised in 1976 to \$23.7 million. AID's primary goal was to increase the GOI's ability to implement the Sederhana program. To further augment the objectives of the Sederhana Irrigation and Land Development I project (No. 497-0242), another project, Sederhana Irrigation and Land Development II (No. 497-0252) was conceived. Sederhana II was financed with a \$25.0 million loan and a \$4.5 million grant.

Funds provided under both projects were to be used principally for reimbursement of:

- local construction costs associated with the completion of small-scale irrigation systems;
- technical assistance to project management; and
- the procurement of vehicles, and as an offset against training costs.

The size of Sederhana subprojects can best be described as small- to medium-scale irrigation systems with a capability of irrigating an individual area of 100 to 2,000 hectares (or about 250 to 5,000 acres). The water supply for these systems is provided by a rudimentary dam made from wire mesh, split bamboo rock baskets, or crude piles of logs or branches across streams. In some locations, sophisticated systems including steel screw-lift gates are used.

According to present projections, a total of 612 subprojects, if approved by USAID/Indonesia, will be eligible for reimbursement under the Sederhana I project. These subprojects were programmed for construction over three GOI fiscal years, 1977-79. To date, USAID has reimbursed 52 subprojects while an additional number of subprojects were being processed for reimbursement during the course of the audit. Of the \$16.5 million of the Sederhana loan set aside for reimbursement for subproject major works construction, approximately \$4.3 million has been approved for reimbursement. No subprojects to be financed by the Sederhana II project have yet to be approved for reimbursement.

For implementation as well as loan reimbursement purposes, the irrigation systems are divided into two categories: "major works" and "on-farm works," with "major works" representing the construction of dams and primary/secondary canals carried out by the Directorate General of Water Resource Development (DGWRD), and the "on-farm works" the tertiary canals and ditches required within the systems to distribute the water to the farmers' fields carried out by the Ministry of Agriculture (MOA).

V. AUDIT FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

A. "Major Works" Component

USAID's initial reimbursement for local construction costs for many "major works" subprojects (individual AID-sponsored irrigation systems), contained supporting documentation that qualified the satisfactory performance aspects of the work. Further, in several of these completed subprojects the amount of reimbursement had not been computed in accordance with established formula.

Subprojects are selected on a basis of defined criteria mutually agreed upon by the GOI and USAID. The approval process includes the submission of a certificate of technical soundness, a design, and a cost estimate.

USAID receives each of these three documents for its review prior to accepting a subproject for reimbursement. Upon completion of the "major works" portion of an irrigation system, the GOI, through its Directorate General of the Water Resources Department (DGWRD), requests reimbursement. However, prior to reimbursement USAID must receive, in addition, a certification from International Engineering Co. (IECO, a consultant consortium including a Taiwanese firm, Sinotech, and an Indonesian engineering firm, who jointly provide technical assistance to the DGWRD on the Sederhana program) that the work completed is satisfactory.

USAID approved \$1.3 million for reimbursement in completed "major works" construction in November 1978. This represented the first drawdown against the loan for reimbursement of construction costs and consisted of 42.5 percent of the cost of 52 completed subprojects. This percentage was mutually agreed on between the GOI and USAID.

In the course of reviewing the files of these subprojects we noted several areas of inconsistency. All subproject files contained a certification by the contractor that work was completed and met the disbursement prerequisites. However, attached as an addendum to many of the certificates were statements by the consultant contractor which qualified the satisfactory performance aspects of the work.

The addenda, while generally agreeing to the basic functioning of the various systems, raised points in many cases regarding their effective utilization. Representative comments covered a range of topics which a typical construction inspector would review before certifying work as satisfactory, ranging from such items as cracks in an embankment, in one instance, to an inoperational intake gate in another.

When asked about the qualifications placed on the certifications, the contractor stated that the various problems cited would be handled through regular GOI maintenance programs.

The subproject files also contained field inspection reports prepared by Mission personnel which identified problems that coincided to a large extent with those noted by the contractor. USAID told us that visits were made to all of the reimbursed subproject sites. This should have resulted in individual field inspection reports for each location.

A review of the 52 reimbursed subproject files indicated that there were no such reports filed for 18 subprojects, and of the 34 reports submitted 22 were incomplete. Each report included a statistical/financial data section, such as the size of the subproject irrigation area, and the construction cost. This information was to be collected by the USAID staff member visiting the subproject site. USAID reaffirmed its position, claiming that field reports were prepared but were not placed in the subproject files. We were unable to verify this statement.

These comments of the field inspection reports, reviewed in conjunction with the contractor's qualified certifications, raise some questions with respect to the satisfactory performance aspects of reimbursed construction work.

Many of the reported problems relating to the subprojects may have been resolved. But without a follow-up system, verification is not possible. USAID/Indonesia has significantly increased the size of the consultant contractor's personnel under a new grant-funded agreement. The additional personnel located at various field site locations should be able to establish a follow-up system to ensure that subprojects are fully functional and utilized prior to certification.

Recommendation No. 1

We recommend USAID/Indonesia initiate a follow-up system, to ensure that all reimbursed "major works" are operational and meet specifications.

Actual reimbursement of subprojects was based on either the approved cost estimate or the contract bid. According to Loan Implementation Letter No. 6 dated January 17, 1978:

When during inspection or AID review of completed subprojects it is discovered that actual costs vary radically from predetermined cost, the subproject shall be reviewed by DGWRD and AID, taking into consideration all available data, including contract and construction costs and, where warranted, the predetermined cost shall be adjusted to reflect a rational basis upon which to calculate the amount to be reimbursed.

Our review of subprojects files indicated a disparity of information on cost estimates and contract bids. Cost estimates were often unsigned, untitled, and in some instances there was no indication that a review had been performed by USAID/Indonesia. Contract cost figures originated from a variety of sources, as for instance field visits and the technical advisory (consultant) contractor. Thirteen subproject files (25 percent) lacked all reference to contract cost figures.

USAID/Indonesia's procedure was to compare subproject cost estimates against contract costs to determine the basis of reimbursement. Once the cost reimbursement basis was established, the Mission's sharing ratio was calculated at 42.5 percent. The estimate predominated as the reimbursement basis, as was demonstrated by 38 out of 52 subproject case histories.

Whenever the cost estimate exceeded the contract cost by ten percent, the contract cost was to be used instead. The use of the ten percent factor was conveyed to us verbally and we were unable to substantiate it

with any written documentation or other evidence. However, we found 10 of the 52 reimbursements were based on cost estimates that exceeded the contract value by over ten percent. Further, a subproject with an approved cost estimate of Rp 26.3 million (US\$42,419) and an actual contract cost Rp 34.3 million (US\$55,323) was reimbursed on the basis of a Rp 13.3 million (US\$21,452) cost figure, subject to the 42.5 percent sharing ratio. The subproject file provided no support for this much lower but arbitrary figure.

In view of the number of errors in the computation of reimbursements noted above, we believe the following recommendation is in order:

Recommendation No. 2

We recommend that USAID/Indonesia

- a) review the documentation and computations supporting the \$1.3 million reimbursement, validate their accuracy, and, to the extent necessary, adjust reimbursements to their proper amounts, and
- b) institute procedures to more accurately monitor reimbursed amounts.

B. "On-Farm Works"

Full utilization of the "major works" component of many subprojects is dependent upon the "on-farm works" portion.

"On-farm works" progress has been very limited and the USAID needs to develop a synchronized time frame for "on-farm works" completion. At the same time a reimbursement formula for "on-farm works" has yet to be developed.

"On-farm works" refers to the construction of tertiary canals and on-farm ditches and drains. The completion of the "on-farm works" will provide the important linkage between the "major works" component of the subproject with the paddy fields. The "major works," i.e., gabion weirs, primary and secondary canals, provide the water for irrigation from its source (river, stream, etc.). The tertiary canals and on-farm ditches distribute the water to the fields.

Although the "on-farm works" are essential to many subprojects, implementation of their construction has been slow. For example: review of the 52 USAID subprojects which were reimbursed for their "major works" component revealed that 20 had not yet begun to construct their "on-farm works." Six of the 52 reimbursed subprojects had completed construction. The other 26 were at various stages of construction.

The statistical data with respect to the "on-farm works" was obtained from quarterly reports prepared by the consultant contractor (IECO). A recent issue stated that information was not available on 9 of the 52 reimbursed subprojects with respect to the "on-farm works."

We were unable to determine why the information was not available, except to speculate that remoteness of some subprojects and the paucity of available information may have contributed to the information gap.

Reimbursement for "on-farm works" requires:

- A certification of completion of construction of 40 percent of the tertiary canals and farm service ditches;
- Evidence that a water user association(s) has been formed and is operating effectively;
- A water management plan for the tertiary canals and farm service ditches;
- An operation and maintenance plan for the tertiary canals and farm service ditches; and
- A certification that private landholdings in excess of 5 and 2 hectares per individual or family do not exceed, respectively, 10 and 25 percent of subproject area.

According to USAID/Indonesia project personnel few, if any, sub-projects meet all of these conditions at present. The Sederhana project paper reflecting GOI policy anticipated that tertiary irrigation and quarternary canals would be constructed by local farmers, with only technical assistance and some commodities provided by the GOI through the provincial agricultural services. This concept proved wrong. In addition, the GOI planners assumed that farmers would be able to borrow money from the Bank Rakyat Indonesia (BRI). Loans from the BRI have been rare, principally because of farmers' lack of land certificates to be used as collateral to secure the loans. Yet another problem has been the hesitancy on the farmers' part to construct tertiaries until the "major works" were constructed and functioning. The lack of ready credit and land certificates were identified by project personnel as the major causes of slow development and progress.

To eliminate this problem the GOI has decided to start a special GOI-funded program to construct tertiary systems for 360,000 hectares in areas where primary and secondary canals exist but water distribution is limited due to the lack of tertiary development. On new Sederhana subprojects the tertiary canals will be designed and constructed by the DGWRD along with the primary and secondary canals.

The USAID takes a more optimistic view of the overall system's effectiveness, notwithstanding the admittedly limited progress of "on-farm works." The USAID notes that about 20 percent of Sederhana's "major works" deliver water to paddy-to-paddy systems which do not require a technically designed and constructed "on-farm" distribution system. At least partial effectiveness is claimed by the USAID's assertion that "even the primary and secondary elements of the 'major works' systems already bring water to the fields of thousands of farmers."

Recommendation No. 3

We recommend that USAID/Indonesia review reimbursed "major works" subprojects and prepare a schedule for the completion of "on-farm works."

Reimbursement procedures for "on-farm works" have yet to be resolved. According to Implementation Letter No. 6 dated January 16, 1978, completed "on-farm works" shall be reimbursed:

42½ percent times the area in hectares for which tertiaries and on-farm ditches and drains have been constructed times the predetermined cost per hectare for survey, design and construction of tertiaries and on-farm ditches and drains.

However,

Reimbursement will not be approved by AID until sufficient tertiaries and on-farm ditches and drains have been constructed to enable 40 percent of the proposed service area to be physically irrigated and drained.

This second clause has caused some concern to USAID/Indonesia because it does not define "service area."

Under the original subproject selection and approval process, a targeted area was established for irrigable land. This area would be irrigated as a result of the completed subprojects for both "major works" and "on-farm works."

While "major works" are programmed for construction in one year, completion of "on-farm works" could take several years. At the completion of "major works," an inspection may be made and reimbursement approved. However, with "on-farm works" extending over several years, USAID/Indonesia has not yet decided whether to reimburse: (a) on a fiscal-by-fiscal year basis, (b) as work is being completed, or (c) only at the completion of the entire subproject. This decision concerning "on-farm works" reimbursements must be resolved before any "on-farm works" subprojects may be reimbursed. Pending such a decision, no payment may be made regardless of completion status.

Recommendation No. 4

We recommend that USAID/Indonesia, in conjunction with the Government of Indonesia, define a complete set of reimbursement criteria for "on-farm works."

C. Water Users Associations

Although considered an essential element in the successful operation and maintenance of small irrigation systems, few water users associations have been organized. For the 52 systems reimbursed by USAID/Indonesia only 20 water users associations have been formed. USAID/Indonesia should promptly review currently reimbursed subprojects to determine the organizational status of water users associations. According to the Sederhana Capital Assistance Paper dated February 20, 1975, the most important element in successful farm level implementation of the Sederhana program is the development of viable water users associations. As part of their activities, the associations are to determine water user charges and fines, allocate funds collected and protest unfair treatment in the division of water.

USAID/Indonesia sponsored a special study of water users associations in Indonesia. The study report concluded that the development of effectively functioning local irrigation institutions was usually a long-term process. Institutional formation may be initiated but not easily accomplished by the kinds of crash programs being used to develop physical infrastructure systems. The report also pointed out that the long-range institutional and technological development of irrigation systems requires a fairly labor-intensive approach on the part of the government's technical and extension personnel.

The early development of water users associations appears to be an absolute necessity for the successful operation of an irrigation system. Because of this vital importance, the formation of these associations is a prerequisite for the reimbursement of "on-farm works."

We offer no formal recommendations because the formation of water users associations is a precondition for reimbursement of the total "on-farm works" package addressed in Recommendation No. 4.

D. Operation and Maintenance

The preparation of an operations and maintenance (O&M) plan for the "major works" has yet to be finalized. Also funds provided by the GOI for operation and maintenance of the completed irrigation systems appear to be inadequate.

Operation and maintenance of "major works" is the responsibility of the district governments (kabupaten), while "on-farm works" are to be operated and maintained by the local community. Implementation Letter No. 6 states:

. . . The long-term benefits from the Sederhana program are dependent upon an effective operation and maintenance program . . . The O&M plans shall cover the "major works" tertiaries and "on-farm

works." The water management plan . . . may be incorporated into the O&M plan for tertiary and "on-farm works."

While not a condition for reimbursement for "major works," the preparation of an O&M plan is a condition for reimbursement for the "on-farm works." To date, O&M plans have been drafted but are yet to be approved and forwarded to field site locations. "On-farm works" reimbursements are therefore mutually dependent on organizing water users associations and an O&M plan.

A June 1978 evaluation of the Sederhana program prepared by a contract team financed by AID stated, when comparing O&M costs against GOI's budgetary provision for O&M, that:

Reports indicate that only Rp 2000 per hectare were budgeted for operation and maintenance. However, studies several years ago by the World Bank and the (GOI) Ministry of Public Works show that Rp 3500 to Rp 3800 per hectare are required for proper maintenance.

The contract team recommended to the GOI a suggested figure of Rp 5000 to Rp 10,000 per hectare for O&M. The GOI has not yet acted upon the suggestion.

None of the reimbursed subprojects have, in effect, formalized operation and maintenance guidelines. Judging by the consultant's certificates of construction completion and the field visits by Mission personnel, systems upkeep represents a problem. To protect USAID/Indonesia's interests, particularly with respect to the subprojects already reimbursed, the Mission should assure itself that each subproject has an approved O&M plan, and that sufficient funds are available to implement it.

Recommendation No. 5

We recommend that USAID/Indonesia promptly complete finalization of the Operation and Maintenance plans with the Directorate General of the Water Resources Department and ensure that the plans are forwarded without delay to the various field site locations for implementation.

Recommendation No. 6

We recommend that USAID/Indonesia, in conjunction with the Government of Indonesia, review operation and maintenance budgetary resources

currently available to ensure that they are adequate to implement the related plans.

E. Evaluation

An effective evaluation system has not been developed to monitor the Sederhana program. The lack of an effective evaluation system precludes judgment concerning the validity of the program's original economic justification.

According to the Capital Assistance Paper prepared for the Sederhana I program and Loan Implementation Letter No. 1 dated January 23, 1976, the GOI would undertake a comprehensive monitorship of program activities. The monitoring plan would provide information on all subprojects, including the status of:

- subprojects as they are developed and reviewed by AID;
- progress and completion of all construction;
- operation and maintenance plans prepared;
- reimbursement requests prepared, approved and disbursed; and
- water users associations formed and on-farm workers completed.

The geographically dispersed nature of the Sederhana program, with subprojects spread over considerable distances in remote areas, coupled to the amount of data to be obtained, suggests that the job of managing a meaningful monitorship program represents a mammoth task.

The scope of work for technical advisory services for the program financed by the AID loan included advice and assistance on monitoring and evaluation procedures. Short-term consulting services provided through IECO began in June 1977.

During the period June-September 1977, questionnaires for the selection and evaluation of subprojects were developed, undergoing several revisions in the process. IECO personnel placed emphasis on the development of a questionnaire to be used by the GOI to obtain data from field site locations. In addition, IECO developed computer programs which would analyze the collected data.

For example, a "Manual on the Analysis for Selection Purposes of Sederhana Irrigation, Reclamation and Land Development Subproject Proposals" was prepared in August 1978. This analysis, according to the manual, was designed to permit evaluation of subprojects to provide sufficient detail for an assessment of the economic feasibility of subprojects, and to furnish baseline data against which the future performance of subprojects could be evaluated.

We acknowledge the importance of this data. However, the manual remains silent with respect to the means by which data collected from the field could be authenticated for accuracy. The manual represents a sophisticated approach for monitoring and evaluating subprojects, but does not appear to give any evidence of adapting its technique to the Indonesian environment.

The GOI has supplied USAID/Indonesia with computer printouts of data collected from field site locations which the Mission is presently studying. A cursory review, however, indicated that the data are in need of refinement. They also appear to lack a summary and/or synopsis of conclusions.

As part of the Sederhana Program's justification, the Capital Assistance Paper developed an economic justification for AID investment based on projected returns. The economic justification concluded that the program was justified on the basis that it would yield increased production of milled rice amounting to about 101,000 metric tons in Indonesian Fiscal Year (IFY) 1978-79, and ultimately about 211,000 metric tons in IFY 1984-85. As a result of the economic analysis performed on the Sederhana I project, an internal rate of return on investment was estimated at 46 percent.

In 1978 USAID/Indonesia sponsored an evaluation of Sederhana's progress. One of the evaluation's conclusions was that for the 1976-77 crop year, a set of 132 subprojects accounted for an annual production increase of 20-30,000 tons of milled rice. The USAID/Indonesia-sponsored evaluation developed the data essential to monitor the Capital Assistance Paper's original economic justification. This baseline data, required to monitor the program and provide a measure by which to judge progress, is not presently available in the GOI's monitorship program.

A more recent USAID evaluation dated November 14, 1979 stated:

GOI, while now appearing to place a greater emphasis on beneficiary analysis than (. . . before . . .), has requested that AID finance the entire computer operation analysis of data already gathered without having a specific proposal on what the analysis is expected to produce. AID should produce a counter-proposal to provide technical assistance for the analysis but only with the full commitment of the GOI.

We agree. However, any counter-proposal should bear in mind the provision of technical assistance in the past and its results. In addition, the compilation of data should be tailored to the Indonesia environment, taking into consideration the unique problems associated with data collection and reducing the quantity of data required to a level which would ensure adequate evaluation and yet not be unwieldy.

In summary: The GOI needs to reorganize its evaluation activities in order to comply with Loan Implementation Letter No. 1. But beyond the mere compliance aspects, the collected data should facilitate an adequate yet practical means for evaluation.

Recommendation No. 7

We recommend that USAID/Indonesia, in conjunction with the Government of Indonesia, review and revise current evaluation policies and procedures in such a way that they will combine the Loan's compliance features with a meaningful evaluation tool on the basis of accurate and well selected source data.

F. Program Funds

The program's rate of implementation is not accurately measurable in terms of conventional financial data. This is due to a large extent to a major funding component being financed under the fixed amount reimbursement (FAR) method whereby payment takes place only upon completion and final acceptance of construction work by AID.

The Sederhana program has been financed by USAID/Indonesia under two loans, with a total value of \$48.7 million and \$4.5 million in grant funds. The first \$20.0 million loan was signed June 30, 1975 and was subsequently amended to increase the amount to \$23.7 million. The second loan was executed August 31, 1978 for \$14.7 million and was later amended to increase the amount to \$25.0 million, for a total program loan financing of \$48.7 million. At the time of the second loan's execution, cumulative disbursements under the first loan were, according to USAID/Indonesia's financial report dated August 31, 1978, approximately \$3.0 million.

Of the \$3.0 million disbursed, 75 percent was paid to a technical assistance contractor, with the remaining 25 percent funding the procurement of 111 jeeps. Loan documents do not provide a composite summary of budgeted loan expenditures but the Capital Assistance Paper does. As originally projected, loan funds were to be used to finance:

Local construction of subprojects	\$17.5 million
Equipment	3.3
Training	0.5
Technical assistance consultant	2.0
Formation of water users associations	<u>0.4</u>
	<u>\$23.7 million</u>

The highest percentage was earmarked for the construction of subprojects. At the time the second loan was executed, three years after the execution of the first, no loan funds had been expended on construction of subprojects. USAID/Indonesia advised us that this was due to the FAR method of reimbursement. Under the FAR method a pre-agreed payment takes place upon physical completion of the construction task and an independent certification attesting to it. The Mission also advised that more and better quality construction had actually taken place but was not yet eligible for reimbursement.

In November 1978, the first installment of reimbursements (1.3 million) for local construction was approved and paid out. During the course of the audit a second installment was approved for approximately \$3.0 million, bringing total approved disbursements to \$4.3 million. We noted, however, that the Project Paper prepared for the second Sederhana loan contained the following statement:

AID should be able to approve for reimbursement approximately \$7.8 million by 9/30/78 with an additional approval of \$5.2 million between 10/1/78 and 7/1/79. (Total disbursements \$13.0 million.)

This has not occurred. The projected reimbursements proved to be overly optimistic, failing to take into consideration certain GOI limitations and operating practices as described in earlier sections. The Mission stressed repeatedly that physical progress--while not reflected in documented data--far exceeded the more modest level of achievements recorded in the published reports, particularly those tied to the lagging reimbursement figures. Recently USAID/Indonesia requested an extension of both the Terminal Date for Disbursement Authorization (TDDA) and the Terminal Date for Disbursement (TDD) for the first loan. In its request the Mission stated that the nearly \$14.0 million loan would not be disbursed if the terminal dates were not extended. USAID/Indonesia requested a new TDDA of July 26, 1981 and TDD of January 26, 1982. AID/Washington approved the extended dates.

Mission officials recently performed an analysis of current reimbursement projections for the first loan which resulted in a projected \$1.8 million deobligation.

G. Provision of Technical Assistance

Technical assistance has been provided to the GOI through contractual services to assist in the accomplishment of project purposes since June 1976. USAID/Indonesia decided in the light of project conditions, and at DGWRD's request, to double the level of assistance, at a correspondingly substantial increase in cost.

The primary function of the advisors, a consortium consisting of International Engineering Co., Sinotech, Inc., and an Indonesian contractor, was to assist the GOI in building up its institutional capability to implement the Sederhana program. The value of the IECO loan-funded contract, originally signed June 9, 1976, was \$3.5 million and called for the provision of services over a three year period.

The Project Paper for the Sederhana II loan, dated July 17, 1978, states:

Experience has shown the critical need for more technical assistance than was provided under Sederhana I. Therefore, this component will be substantially increased for Sederhana II and be provided on a grant basis.

From this statement we conclude that the technical assistance provided under Sederhana I was insufficient. The statement, however, does not explain the switch from loan to grant funds. AID/Washington raised the identical question in an October 4, 1979 cable:

Since engineering services (both for detailed design and for project supervision) have traditionally in the past been loan-funded, at least for major infrastructure projects, we suggest that GOI should be receptive to at least partial loan funding of such TA (Technical Assistance).

USAID/Indonesia replied five days later:

. . . TA is quite different from traditional TA for engineering design and construction supervision, and is not susceptible to loan financing without very serious negative consequences.

The negative consequences refer to difficulties in obtaining qualified contract personnel under conditions where the GOI provides the logistics support. IECO experienced substantial difficulties with the level and quality of GOI's logistics support provided under its original contract.

IECO signed a new \$4.0 million grant-funded contract on June 10, 1979 for services to be provided over a 13-month period.

The substantial increase in contract cost is principally attributable to a large build-up in contractor personnel and by USAID/Indonesia's absorption of a large percentage of the logistics support. While accepting the physical limitations associated with GOI logistics, we cannot disregard the lack of GOI financial support for the cost of the technical assistance. For example, under its new contract IECO's housing costs amount to \$402,920. Under its previous contract IECO's housing costs were assumed by the GOI.

During 1979, when surveying logistics support to contractors in Indonesia, we had arrived at the conclusion that USAID/Indonesia was using good judgment in determining, on a case-by-case basis, the type of support each contractor ought to receive in order to be most effective. Therefore, while the assumption by the Mission of a substantial housing cost component may seem to amount to a heavy premium, in absolute monetary terms, it may actually be more economical in terms of greatly improved productivity and morale.

USAID/Indonesia will be executing a new contract for Sederhana-related technical services in July 1980, with proposed grant financing. USAID/Indonesia should explore ways and means to increase GOI's financial support of the contract, with particular emphasis on offsetting housing costs on some kind of a sharing basis.

Recommendation No. 8

We recommend that USAID/Indonesia, prior to the execution of its new technical advisory contract, explore ways and means by which the Government of Indonesia will absorb a more substantial portion of the contractor's logistics support costs.

PHOTOGRAPHS

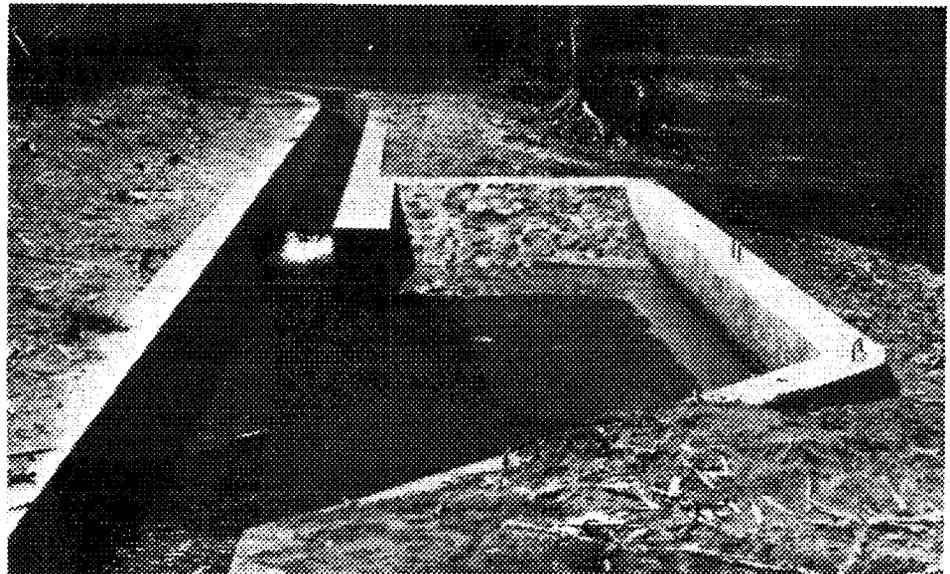
JAVA

*Irrigated rice fields
(West Java)*



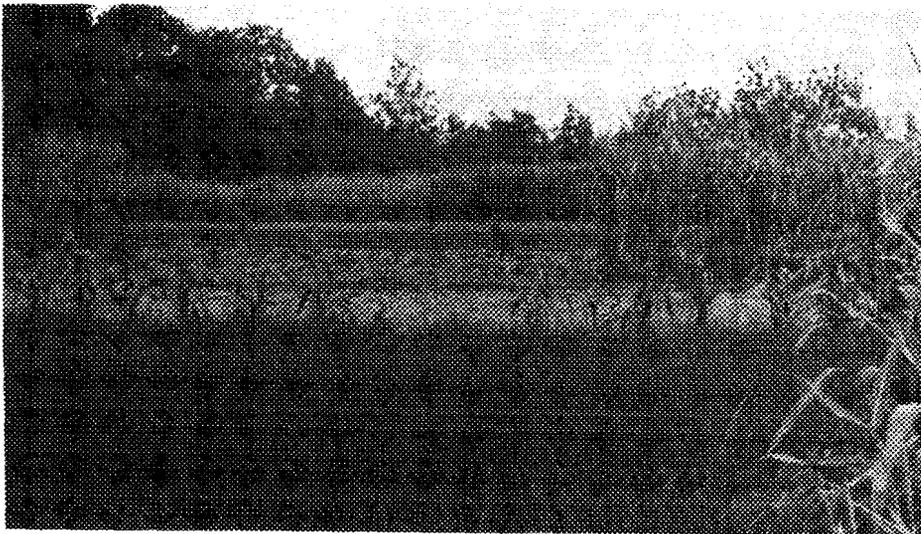
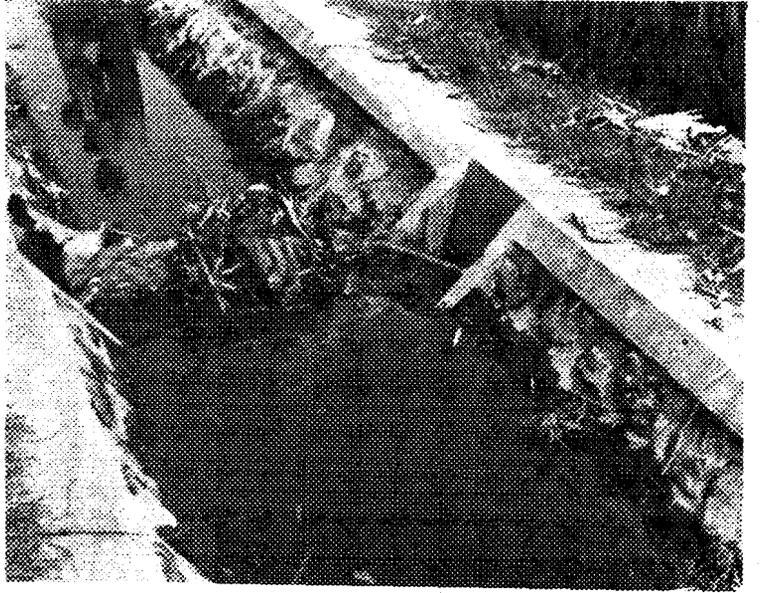
*This canal was built by the
community. There is no water
for this irrigation canal.
(West Java)*

*Additional structure added to
the canal so that people
washing buffaloes and cows
will not destroy the lined canal
with the animals.
(Yogyakarta)*



JAVA

*Stop logs control the flow of water.
(Yogyakarta)*



*Sugar cane fields being
converted to wet rice fields.
(Yogyakarta)*

*Secondary canal being lined at
community expense.
(Yogyakarta)*



NORTH SUMATRA

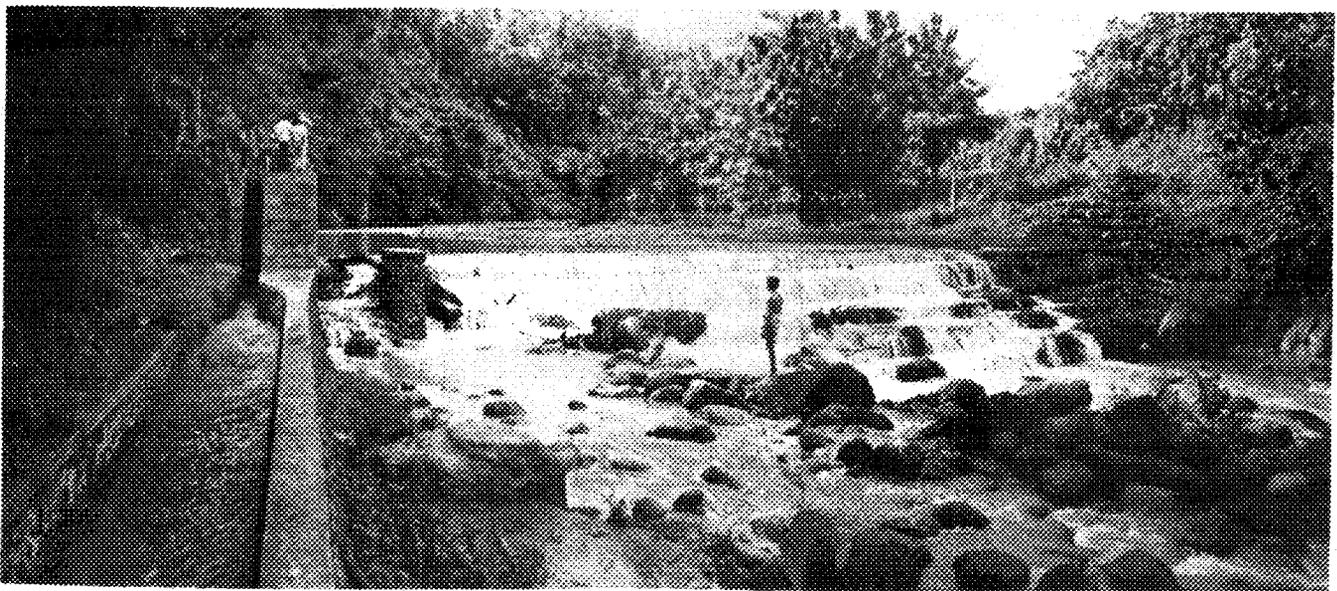


RISHA DUMA SUBPROJECT KABUPATEN DAIRI

Building the primary canal

"Since you have come here and since the government has already spent a lot for this dam we are prepared to release our land for the irrigation as long as we get com-

pensation payment. However, we are not going to use one drop of the water because we don't need it."



Masonry Weir

NORTH SUMATRA
NAMU EMPILIN SUBPROJECT
KABUPATEN LANGKAT



Masonry weir working well



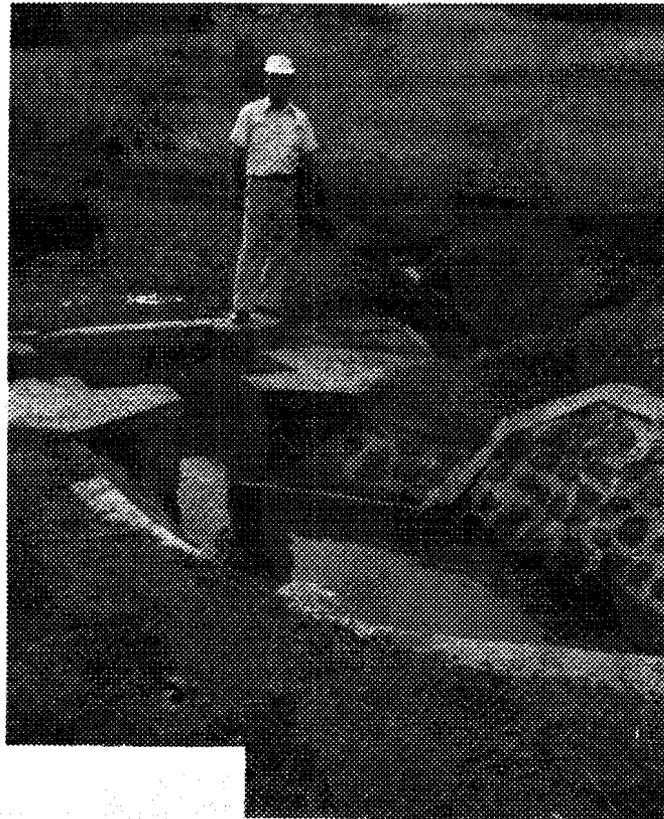
New Rice Fields

SOUTH SULAWESI

PANAIKANG II SUBPROJECT BANTAENG



Walking along the lined canal of Panaikang II



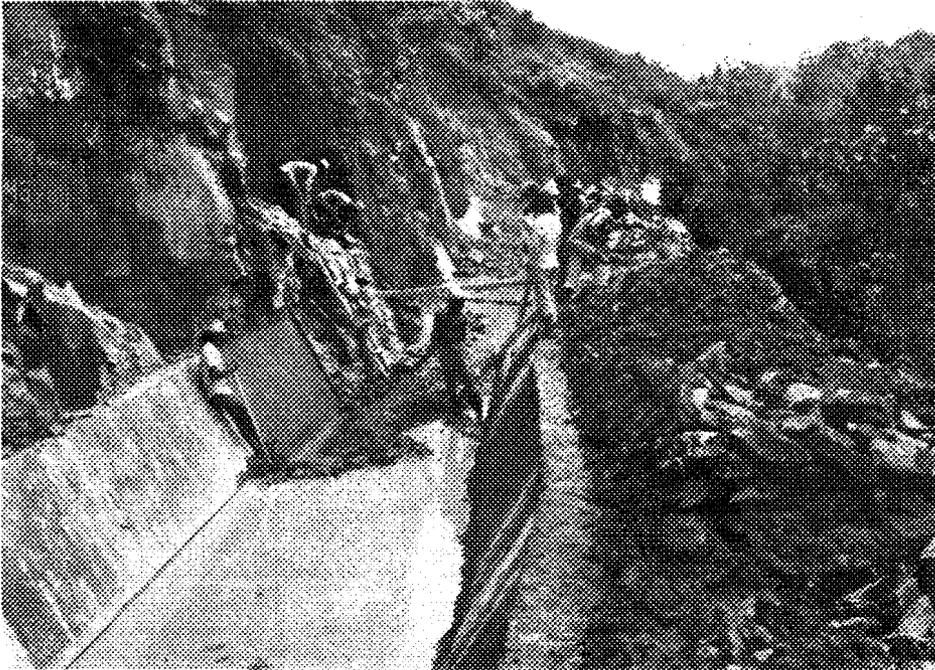
*Mr. Tai (Sinotech) on a weir
functioning tertiary structure*



CAKURA SUBPROJECT KABUPATEN TAKALAR

P3A, Water Users Association Office

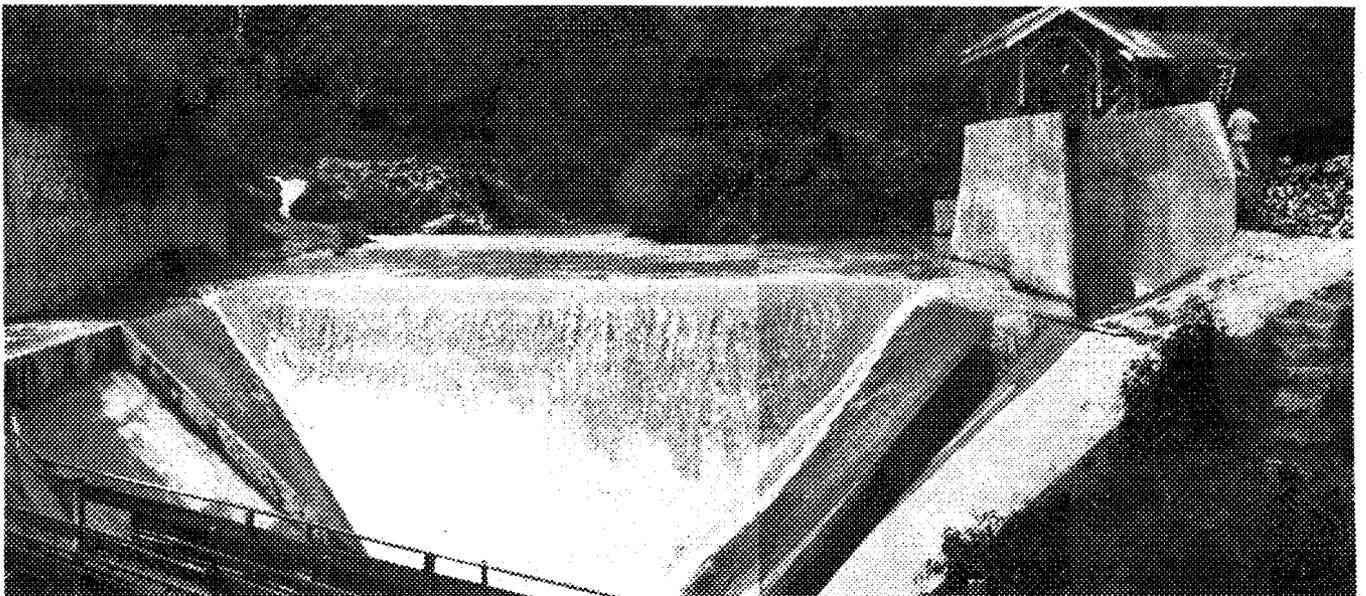
**SOUTH SULAWESI
BABANA SUBPROJECT
KABUPATEN BULUKUMBA**



Illegal free intake beside the weir; the intake canal and stream.

"I told Public Works about the problem of the spring which is located above the weir. Before they built it I told them we wouldn't get enough water through this weir" Village Chief, Babana Subproject.

**BIANG LOE II SUBPROJECT
BANTAENG**



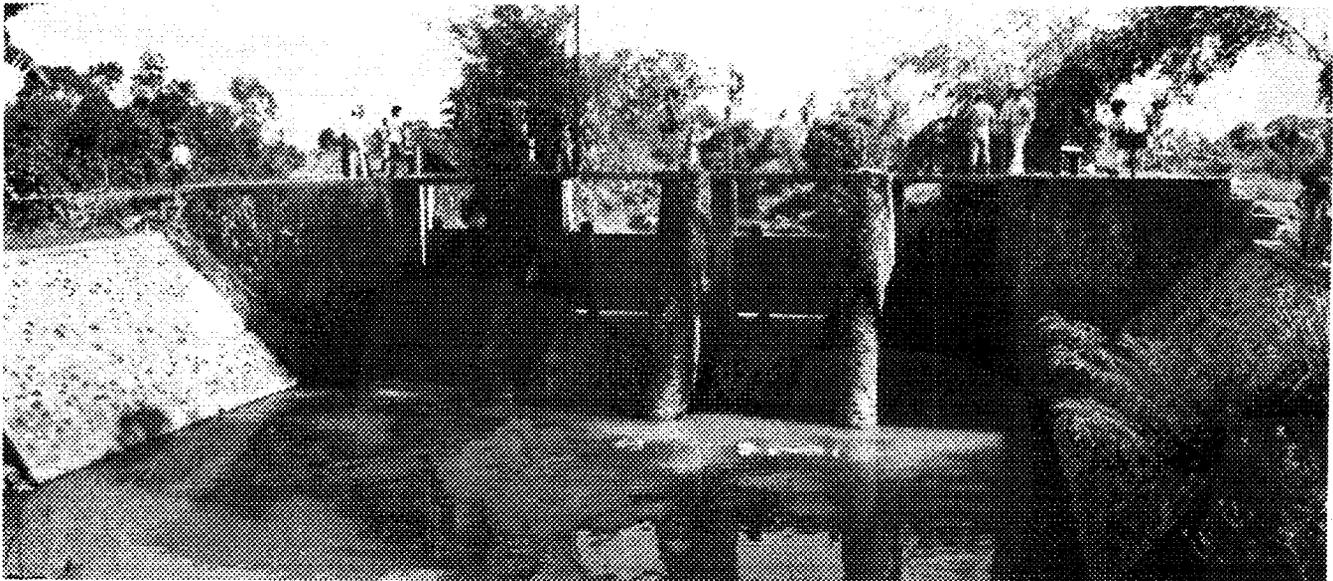
Gabion (Rock Crib) weir of Baing Loe II

SOUTH SULAWESI
CAKURA SUBPROJECT
TAKALAR



Eroded weir

KABUPATEN SUBPROJECT
GOWA



*New weir and control gates of Bontomanai
(78/79 Improvement).*

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